APPENDIX E

TECHNICAL MEMORANDUM #1

Waterloo Sanitary Servicing Master Plan Technical Memorandum No. 1: Existing State Geodatabase

Final October 9, 2013

Revision Record							
Revision	Description	Prepared By		Checked By		Approved By	
1	Initial Draft	NS		DE		AC/LM	
2	Final	NS		DE		AC/LM	

Stantec

WATERLOO SANITARY SERVICING MASTER PLAN TECHNICAL MEMORANDUM NO. 1: EXISTING STATE GEODATABASE

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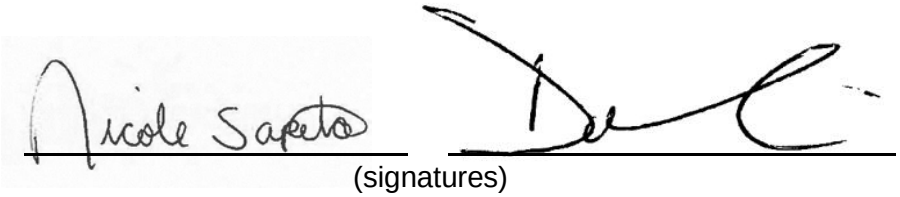
Prepared by  (signatures)

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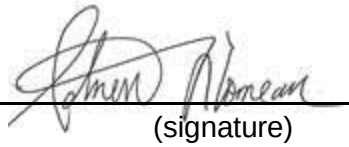
Reviewed by  (signature)

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Appendix A: Trunk Sewers Profile Review

1.0 Introduction

The City of Waterloo (City) has retained Stantec Consulting to complete the Waterloo Sanitary Servicing Master Plan (Master Plan). The purpose of the Master Plan is to provide an update to the 2002 City Wide Sanitary Sewer System Update – Master Plan (WSSS) (AECOM, 2002) to account for updated population and employment growth projections up to a 2031 planning horizon. Priority and strategic projects will be evaluated to efficiently and effectively continue to operate the system, implement best management practices (including Infiltration/Inflow (I/I) monitoring and mitigation approaches), and optimize staging of the sanitary capital program.

The following tasks will be carried out for the completion of the Master Plan:

- Task 1: GIS Sanitary Quality Control and Field Verification
- Task 2: Hydraulic Needs Assessment
- Task 3: Hydraulic Model Benefit/Cost Analysis
- Task 4: Hydraulic Model Development, Train, and Implement
- Task 5: Flow Monitoring and Inflow/Infiltration
- Task 6: Public Consultation
- Task 7: Master Plan

Task 1 includes data review and validation of the existing sanitary system and the development of a current state geodatabase for model input. Data provided for Task 1 includes physical attributes required for hydraulic modeling and surface area data to support model loading. Additional information will be required for the development of the model, including information regarding existing sanitary flows, population planning data, flow monitoring data, and pump station monitoring data. This time varying data information is related to determining flow rates and calibrating the model. An overview of time-varying data is provided in this memo, however, it will be addressed in greater detail as the model development progresses and more information is available.

The purpose of this memo is to summarize and document the review of data for use in developing a model for the sanitary collection system and to complete quality enhancements to the sanitary GIS data. The review includes two forms: gap assessment, and data confidence for model application. The data review was undertaken in GIS in both ESRI ArcMap and hydraulic modeling software utilizing their built-in analysis tools. The sewer data provided from the City was provided in a geodatabase format that was subsequently converted into individual shapefiles for transfer to the modeling environment.

2.0 Data Gap Assessment

2.1 PHYSICAL ASSET DATA

2.1.1 Data Inventory

The following physical asset data was received from the City:

- Manholes
- Gravity Mains
- Pressurized Mains
- Control Valves
- Network Structures (Pump Stations)

2.1.1.1 Manholes

The manhole shapefile contains a number of attribute fields to define physical parameters and provide additional relevant information. For the purposes of hydraulic modeling, the most important manhole attribute is the top of manhole elevation. It can be noted that the attribute fields included in the manhole shapefile also indicate locations of drop structures. This information is useful for reference in the confirmation of pipe profile alignments. Drops across manholes could indicate inconsistent profiles, in which case the location will be identified and reviewed through the data verification process.

Based on the data provided, there are 6,511 manholes in the City's sanitary geodatabase. This includes active, proposed, private, temporary, and abandoned manholes. A summary of the relevant attribute fields for manholes and the initial gap assessment is provided in Table 1.

Table 1: Overview and Initial Assessment of Manhole Data

Field Name	Description	Input Notes	Gap Assessment
MXASSETNUM	Unique identifier, corresponds with the Maximo ID	Numeric ID	498 blanks, no duplicates (8%)
ENTNAME	Former unique identifier, manhole reference name	Letter/Numeric ID	N/A
TOPOFMANHO	Top of manhole elevation (mASL)	Text Entry	638 blanks (10%)
TOPOFMH	Top of manhole elevation (mASL), considered to be more accurate between the two manhole elevation fields	Numeric Entry	696 blanks, 11 "111.111" entries indicating the asset exists but must be field verified (11%)
POSITION	Description indicating the quality of the source position (x,y) data	Text Entry	N/A

As MXASSETNUM is the unique identifier for manholes, it is important for this field to be populated to import data into modeling software, track attribute updates, and transfer information between Stantec and the City. In the case of private or proposed manholes, an ID is not required for updates to the existing state geodatabase. Manholes missing entries for MXASSETNUM were reviewed to determine if an ID must be populated. Review of the blank MXASSETNUM fields indicates that of the active manholes, six will require IDs to be generated. The remaining blank fields correspond to private, temporary, or proposed manholes.

Entries for TOPOFMH fields are important for completing hydraulic modeling and assessing the impact of potential surcharges in the sanitary system. Blank entries for these fields will be generated based on the methodology for data correction and gap closure described in Section 4.

2.1.1.2 Gravity Mains

The gravity mains shapefile contains a number of attribute fields to define physical parameters and provide additional relevant information. For the purposes of hydraulic modeling, the most important attributes for gravity mains are upstream manhole, downstream manhole, slope, upstream invert, downstream invert, diameter, and length. It can be noted that based on the data provided, there are 6,921 gravity mains in the City's sanitary geodatabase. This includes active, proposed, private, temporary, and abandoned gravity mains.

A summary of the relevant attribute fields for gravity mains and the initial gap assessment is provided in Table 2.

Table 2: Overview and Initial Assessment of Gravity Main Data

Field Name	Description	Input Notes	Gap Assessment
MXASSETNUM	Unique identifier, corresponds with the Maximo ID	Numeric ID	568 blanks, 19 duplicates (8%)
ENTID	Former unique identifier, pipe reference name	Numeric ID	N/A
ENTNAME	Upstream and downstream manhole reference (based on Manhole ENTNAME field)	Letter/Numeric IDs for upstream and downstream manhole ENTNAME	N/A
FROMMH	Upstream manhole reference based on manhole ENTNAME	Letter/Numeric ID	588 blanks (8%)
TOMH	Downstream manhole reference based on manhole ENTNAME	Letter/Numeric ID	583 blanks (8%)
UPSTREAMIN	Upstream invert elevation (mASL)	Numeric Entry	486 blanks, 147 "111.111" entries indicating the asset exists but must be field verified (9%)

Field Name	Description	Input Notes	Gap Assessment
DOWNSTREAM	Downstream invert elevation (mASL)	Numeric Entry	484 blanks, 140 “111.111” entries indicating the asset exists but must be field verified (9%)
SHAPE_Leng	Pipe length (m)	Numeric Entry	No blanks, 31 pipes with a length less than 5 m (<1%)
SLOPE	Pipe slope (%) calculated based on upstream invert, downstream invert, and length.	Numeric Entry	535 blanks, 154 “111.111” entries indicating the asset exists but must be field verified, 365 slopes indicating anomalies (15%)
DIAMETER	Pipe diameter (mm)	Numeric Entry	88 blanks, 92 “111.111” entries indicating the asset exists but must be field verified (3%)
POSITION	Description indicating the quality of the source position (x,y) data	Text Entry	N/A

As noted in the review of the manhole data, it is important for the MXASSETNUM field to be populated for the gravity mains to import data into modeling software, track attribute updates, and transfer information between Stantec and the City. It is also important that these values are unique with no duplications. In the case of private or inactive (proposed or abandoned) gravity mains, an ID is not required for updates to the existing state geodatabase. Gravity mains with missing or duplicate entries for MXASSETNUM were reviewed to determine if an ID must be populated. Review of the blank MXASSETNUM fields indicates that of the active gravity mains, 46 will require IDs to be generated. The remaining blank or duplicate fields correspond to private, abandoned, temporary, or proposed gravity mains, of which some may be required for modeling.

Entries for FROMMH, TOMH, UPSTREAMIN, DOWNSTREAM, and DIAMETER fields are important for completing hydraulic modeling and assessing the capacity of the sanitary sewers. Blank entries for these fields will be generated based on the methodology for data correction and gap closure described in Section 4. Fields such as SHAPE_Leng and SLOPE are also important for modeling; however, they can be determined based on known information and GIS tools if the FROMMH, TOMH, UPSTREAMIN, and DOWNSTREAM fields are populated. The entries in the geodatabase for SHAPE_Leng and SLOPE were also of importance for validating geodata. Discrepancies between automatically populated values and the geodatabase entries were used to help identify connectivity errors that may be problematic when developing the model.

2.1.2 Pressurized Mains

The pressurized main (forcemain) shapefile contains a number of attribute fields to define physical parameters and provide additional relevant information. For the purposes of hydraulic modeling, the most important attributes for pressurized mains are upstream invert, downstream invert, diameter, length, and material. It can be noted that based on the data provided, there are currently 42 pressurized mains in the City's sanitary geodatabase. This includes active, proposed, private, temporary, and abandoned pressurized mains.

A summary of the relevant attribute fields for pressurized mains and the initial gap assessment is provided in Table 3.

Table 3: Overview and Initial Assessment of Pressurized Main Data

Field Name	Description	Input Notes	Gap Assessment
MXASSETNUM	Unique identifier, corresponds with the Maximo ID	Numeric ID	5 blanks, no duplicates (12%)
UPSTREAMIN	Upstream invert elevation (mASL)	Numeric Entry	42 blank (100%, all fields)
DOWNSTREAMIN	Downstream invert elevation (mASL)	Numeric Entry	41 blanks (98%, one field populated)
DIAMETER	Pipe diameter (mm)	Numeric Entry	1 blank (2%)
MATERIAL	Description of pipe material	Text Entry	13 blanks (31%)
SHAPE_Leng	Pipe length (m)	Numeric Entry	No blanks (0%)
POSITION	Description indicating the quality of the source position (x,y) data	Text Entry	N/A

Blank entries for pressure main MXASSETNUM fields were reviewed and two of these entries will require IDs to be generated. The remaining three blank entries correspond to private or abandoned pressure mains.

Entries for UPSTREAMIN, DOWNSTREAMIN, DIAMETER, and MATERIAL are important for completing hydraulic modeling and assessing the capacity of the forcemains. Blank entries for these fields will be generated based on the Data Validation methodology described in Section 3. As mentioned in Section 2.1.1.2, fields such as SHAPE_Leng are beneficial to identify potential connectivity errors in the geodatabase.

2.1.3 Control Valves

Control valves in a sanitary collection system are typically related to the operation of pump stations and pressurized mains. In some applications, control valves are used on gravity mains to direct or split flow. The City has provided information regarding control valves; however, this data is not generally required for the purposes of the hydraulic model. The data files will be

referred to for background information, however, a data gap assessment and data validation is not required at this time.

2.1.4 Network Structures (Pump Stations)

The Network Structures shapefile contains a number of attribute fields to provide relevant information. The majority of the physical parameters required for hydraulic modeling are not included, however, the shapefile provides a description of the network structure (ENTNAME) and a description indicating the quality of the source position (x,y) data (POSITION).

Additional information regarding the pump stations has been provided to collect data that may be beneficial for hydraulic modeling. The extent of the data required is dependent on the preferred approach for model development, which will be determined in subsequent tasks of the Master Plan. The currently available information and data source for network structures that have been collected are summarized in Table 4. Additional information will be gathered as required based on the hydraulic model needs.

Table 4: Overview of Network Structure Data

Parameter	Data	Data Source
Beaver Creek SPS		
Wet Well Dimensions (length/width)	9.3 m / 5.4 m	As Recorded Drawings
Wet Well Floor Elevation	333.45 mASL	As Recorded Drawings
Influent Sewer Invert Elevation	336.15 mASL	As Recorded Drawings
Pump Station Capacity	114 L/s	Beaver Creek Sewage Pumping Station and Forcemain Capacity and Condition Assessment (Gamsby and Mannerow Limited, 2012)
Colonial SPS		
Wet Well Dimensions (length/width)	Information Not Currently Available	Information Not Currently Available
Wet Well Floor Elevation	Information Not Currently Available	Information Not Currently Available
Influent Sewer Invert Elevation	Information Not Currently Available	Information Not Currently Available
Pump Station Capacity	225 L/s (To Be Verified)	Certificate of Approval
Bridgeport SPS		
Wet Well Dimensions (length/width)	Information Not Currently Available	Information Not Currently Available
Wet Well Floor Elevation	Information Not Currently Available	Information Not Currently Available
Influent Sewer Invert Elevation	Information Not Currently Available	Information Not Currently Available

Parameter	Data	Data Source
Pump Station Capacity	205 L/s	Certificate of Approval
Frobisher SPS		
Wet Well Dimensions (length/width)	2.4 m diameter	Certificate of Approval
Wet Well Floor Elevation	Information Not Currently Available	Information Not Currently Available
Influent Sewer Invert Elevation	Information Not Currently Available	Information Not Currently Available
Pump Station Capacity	39.5 L/s	Certificate of Approval
Malabar SPS		
Wet Well Dimensions (length/width)	2.4 m diameter	Certificate of Approval
Wet Well Floor Elevation	310 mASL (Design Value)	Malabar Sewage Pumping Station Capacity Design (MTE Consulting Inc., 1989)
Influent Sewer Invert Elevation	311.5 mASL (Design Value)	Malabar Sewage Pumping Station Capacity Design (MTE Consulting Inc., 1989)
Pump Station Capacity	3.8 L/s	Certificate of Approval
Millennium SPS		
Wet Well Dimensions (length/width)	5 m / 3.5 m	Certificate of Approval
Wet Well Floor Elevation	318.5 m (Design Value)	Millennium Park Sewage Pumping Station and Forcemain Design Brief (Stantec, 2000)
Influent Sewer Invert Elevation	313.25 (Design Value)	Millennium Park Sewage Pumping Station and Forcemain Design Brief (Stantec, 2000)
Pump Station Capacity	109 L/s (To Be Verified)	Certificate of Approval
Northlands SPS		
Wet Well Dimensions (length/width)	3.5 m / 3.5 m (Cell 1) 3.5 m / 3.5 m (Cell 2) (Design Values)	Tender Drawings (P1.1) (MTE, 2011)
Wet Well Floor Elevation	321.2 mASL (Design Value)	Tender Drawings (P1.3) (MTE, 2011)
Influent Sewer Invert Elevation	324.2 mASL (Design Value)	Tender Drawings (P1.3) (MTE, 2011)
Pump Station Capacity	63 L/s (Design Value)	Design Brief: Northland Sewage pumping Station (MTE, 2011)

2.2 DRAINAGE AREA DATA

2.2.1 Data Inventory

The following drainage area data was received from the City:

- Sewershed Areas ("ssCatchmentArea"); and
- Subcatchment Areas ("XPSWM_SubcatchmentAreas")

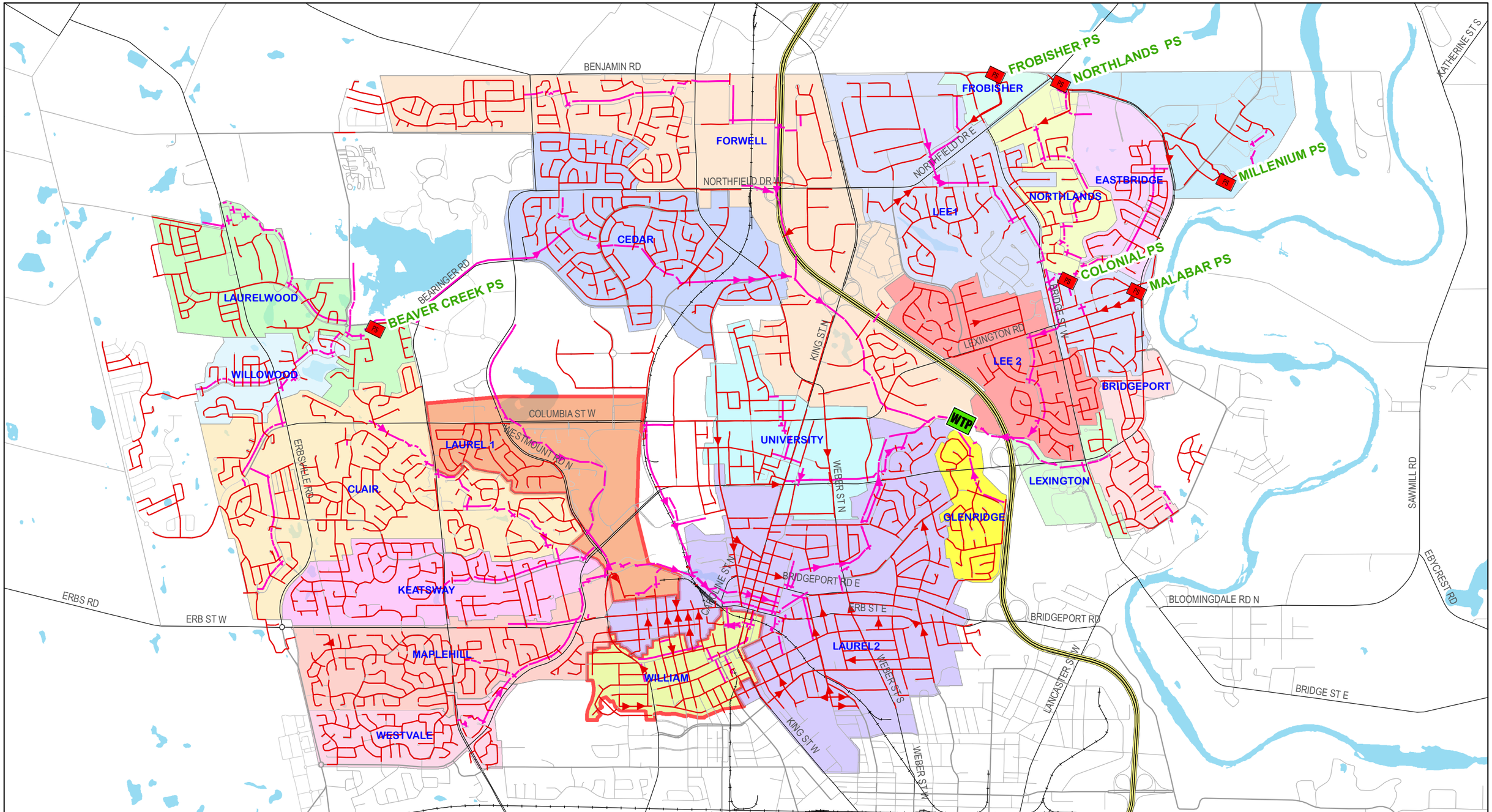
2.2.2 Sewershed Areas

The "ssCatchmentArea" contains attribute fields for name, length, and area and represent the City Wide Sanitary Sewer System Update – Master Plan (WSSS) (AECOM, 2002) delineated trunk and pump station sewershed boundaries. Figure 1 illustrates the sewershed areas provided.

A review of the provided information reveals that some system sewers are not assigned to a sewershed (Central Laurel, William Street, new development), or in the case of the area southwest of Columbia Street and Erbsville Road, the sewers are incorrectly identified as part of the Clair Trunk when they flow northerly via Willowood to the Beaver Creek PS. In addition, once received, external sewershed contributions from Kitchener, Woolwich, and Regional facilities will be incorporated into the final existing state sewershed boundaries.

2.2.3 Subcatchment Areas

Subcatchment areas were developed as part of the trunk model development in XP-SWMM for the WSSS (AECOM, 2002). As part of this study, subcatchment areas will be redefined to reflect recent changes and new development in the City. In addition, it can be noted that the subcatchment delineation is currently at a coarse level, which will be re-evaluated as part of the Master Plan and model needs assessment. The subcatchment area shapefile contains multiple attribute fields to define physical parameters and provide additional relevant information and will only be used as reference in the current study. The subcatchment areas provided are illustrated in Figure 2.



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Legend

Transportation Network
- Arterial
- Collector
- Highway
- Local

- Water Body
- Existing Pump Station
- Wastewater Treatment Plant

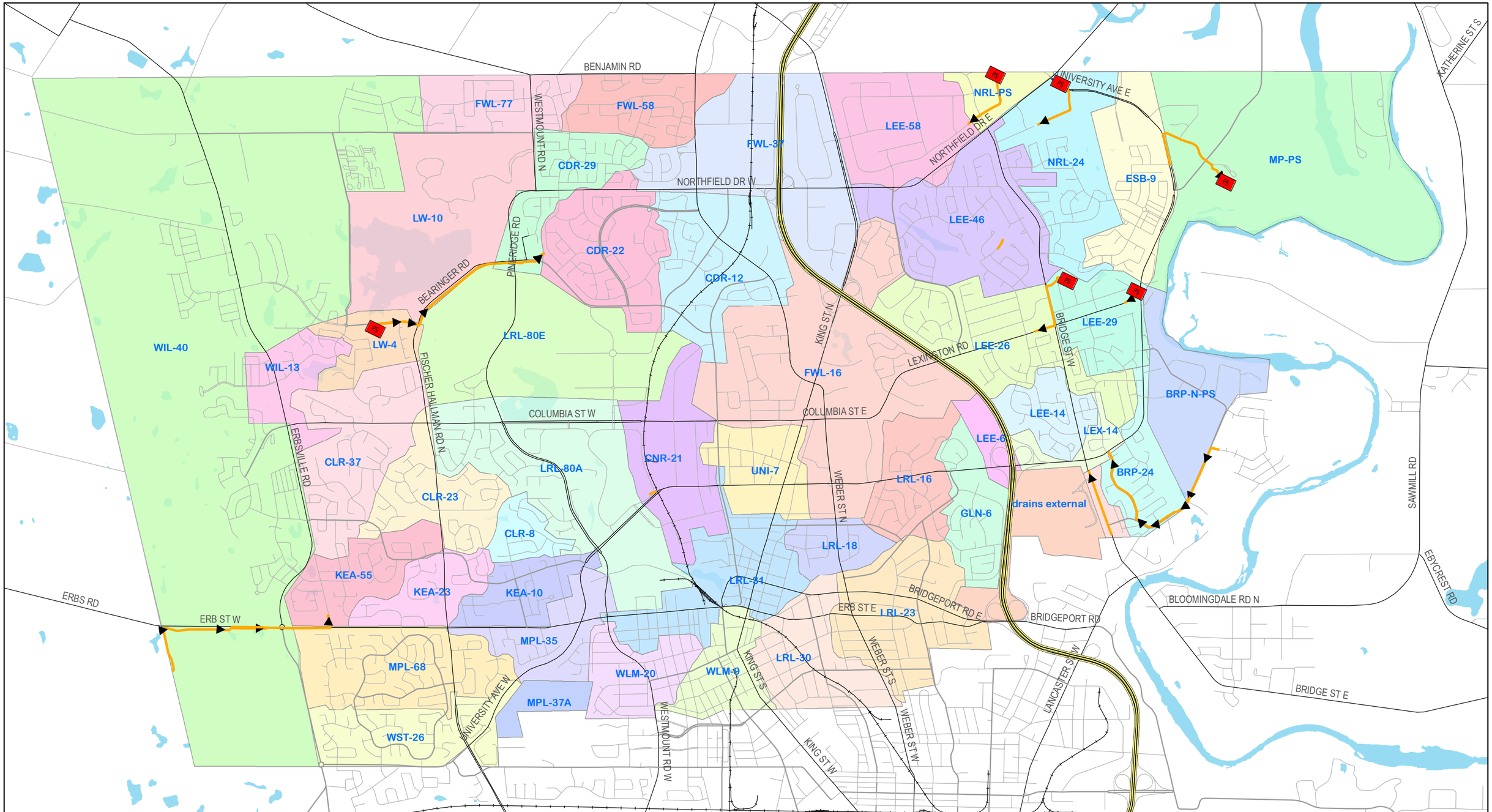
Sanitary Sewers
- Local Sewers
- Trunk Sewers
- Sanitary Sewershed (c. 2002)

1611-11191

Figure No. 1

Title **EXISTING STATE SEWERSHEDS**

Client/Project CITY OF WATERLOO SANITARY SERVICING MASTER PLAN UPDATE



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Legend

Transportation Network
- Arterial
- Collector
- Highway
- Local

- Water Body
- Forcemain
- Existing Pump Station

- XP-SWMM Subcatchments (c. 2002)

1611-11191

Figure No. 2

Title **2002 MODELED SUBCATCHMENT AREAS**

Client/Project CITY OF WATERLOO SANITARY SERVICING MASTER PLAN UPDATE

3.0 Data Validation

Data validation is the process of confirming the hydraulic continuity and suitability of physical sewer data in terms of profile connectivity. Most modern modeling software packages include routines and queries to help perform validations. The following section summarizes the initial data validation exercise.

3.1 CONNECTIVITY REVIEW

Unique manhole IDs are critical in modeling software to provide identification for both nodes and conduits. As indicated in Section 2.1.1.1, the MXASSETNUM field is to be used as the unique identifier; therefore, IDs were assigned for the six active manholes with blank entries for this field prior to importing data (STAN1 through STAN6). For the purposes of modeling, three (3) dummy nodes were added to represent outfalls for conduits in the City Existing State geodatabase. These nodes were also assigned dummy MXASSETNUMs to allow the conduits to be properly imported for the connectivity review (STAN7 through STAN9). Table 5 summarizes the identifiers temporarily assigned to manholes/nodes that are missing MXASSETNUMs or were added for the purposes of modeling. It can be noted that although STAN1, STAN2, and STAN5 are active manholes and were assigned IDs as part of the connectivity review, they are owned by the City of Kitchener.

Table 5: Summary of Missing Unique Identifiers for Active Manhole

ID	TM1 MXASSETNUM	ENTNAME	X	Y
N/A	STAN9		539936	4814958
N/A	STAN8		533071.7	4814949
N/A	STAN7		541903.6	4815089.2
6248	STAN6	K23-11A	535742.4	4811090.3
4567	STAN5	Private	538789	4811463
2527	STAN4	LRL-1C	539660	4815058
2478	STAN3	WS26-36A	536115.7	4809731.2
2311	STAN2	KIT	538731.9	4811507.3
1286	STAN1	KIT	538873.3	4811590.1

It was also noted in the connectivity review that the “To Manhole” and “From Manhole” fields in the geodatabase for gravity mains were based on the old unique identifiers ENTNAME, rather than MXASSETNUM. A correlation between the ENTNAME and MXASSETNUM fields was

completed in Excel to correct the discrepancy. The MXASSETNUM field for gravity mains was not generated for the blank fields at this time.

An initial connectivity review was completed by identifying isolated sections of the network and making corrections in cases where data was not connected correctly or 'To/From' references were mislabeled.

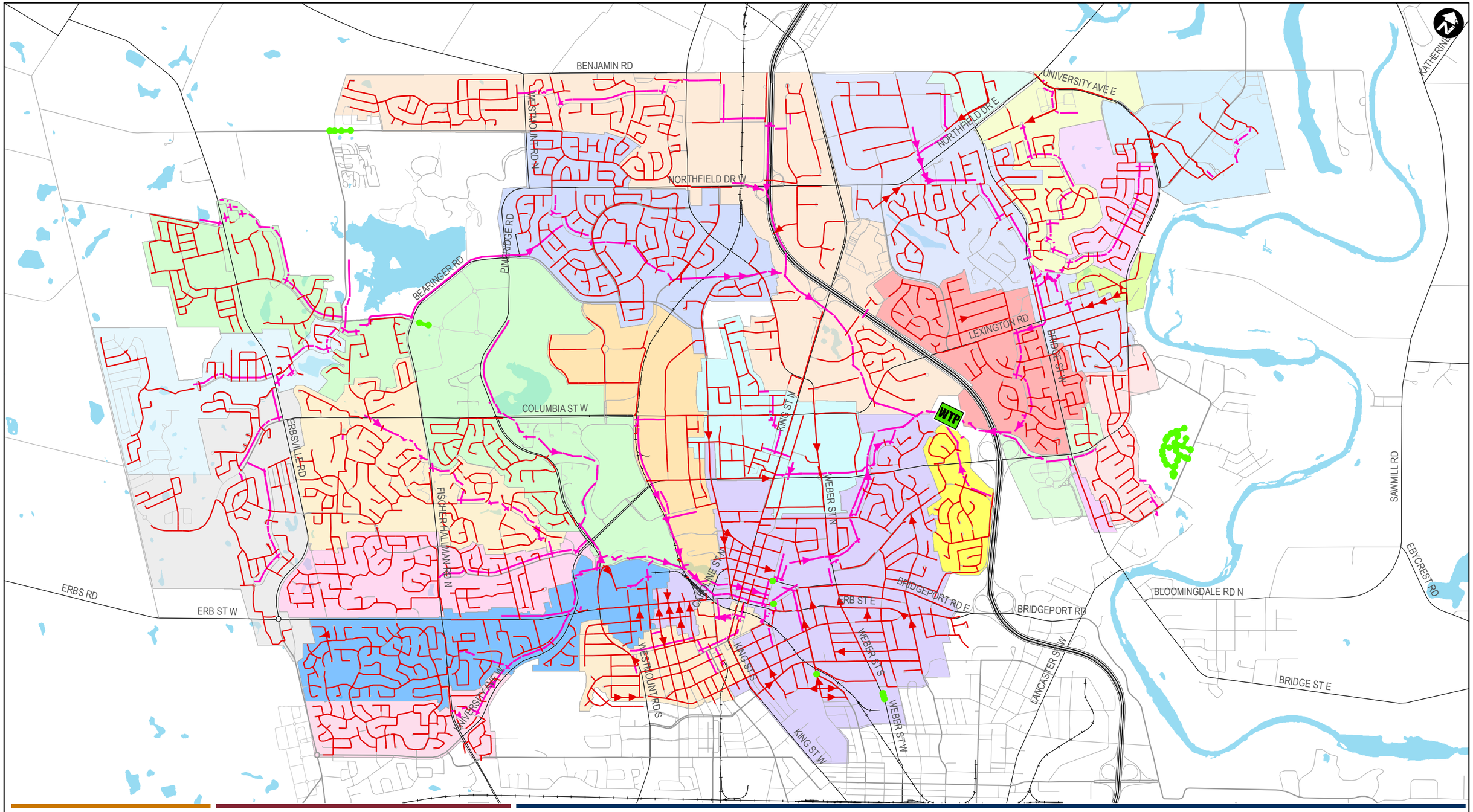
Typical connectivity issues include the following errors:

- Duplicate or blank manhole ENTNAME fields in the geodatabase that caused errors in the correlation between ENTNAME and MXASSETNUM
- "To Manholes" and "From Manhole" specifying connectivity that did not match the conduit geospatial location, or mislabeled 'To/From' references
- Manholes with no connecting conduits
- Isolated areas of the network that do not have downstream connectivity data indicating where flow is directed (i.e. Kiwanis, Conservation Drive, etc.).

All corrections made as part of the connectivity review were flagged as CC (Connectivity Correction) for each asset. Corrections to connectivity were not made in cases where additional follow up was required to confirm connectivity or how flow is directed in the system such as the following (refer to Figure 3):

- Sewer network west of Woolwich St between Sunbridge Cres. and Hawkswood Dr.
- Sewer on Conservation Dr. near the intersection with Roy Schmidt Rd.
- Sewer on Weber St near the intersection with Roger St.
- Sewer east of Fischer Hallman Rd. near the intersection with Laurelwood Dr.
- Manholes 10158, 12452, and 14747 which are currently disconnected from the collection system

The Kiwanis neighbourhood was also disconnected from the collection system and indicated significant data gaps; however, this area is located in the City of Kitchener. At this time, all infrastructure in this area was removed from the data set and it is recommended that a point load be used to represent flow from this area that is directed into the Waterloo sanitary system via the Falconridge PS. This will allow resources to be better used to close data gaps specific to the City of Waterloo infrastructure. SCADA data with historical flows from Falconbridge SPS will be required to accurately define this point load.



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Legend

Transportation Network
- Arterial
- Collector
- Highway
- Local

Sanitary Sewers
- Local Sewers
- Trunk Sewers
- Disconnected Pipe
- Disconnected Manhole

- Water Body
- WTP — Wastewater Treatment Plant
- Sanitary Sewershed

1611-11191

Figure No. 3

Title **DISCONNECTED INFRASTRUCTURE REQUIRING DATA CONFIRMATION**

Client/Project CITY OF WATERLOO SANITARY SERVICING MASTER PLAN UPDATE

3.1.1 Profile Data Review

Manhole and gravity sewer data was reviewed to identify gaps or potential errors that impact the profiles of the sanitary sewer. Missing pipe inverts, pipe diameters, and manhole elevations were reviewed in the context of the location and pipe diameter and are illustrated in Figure 4.

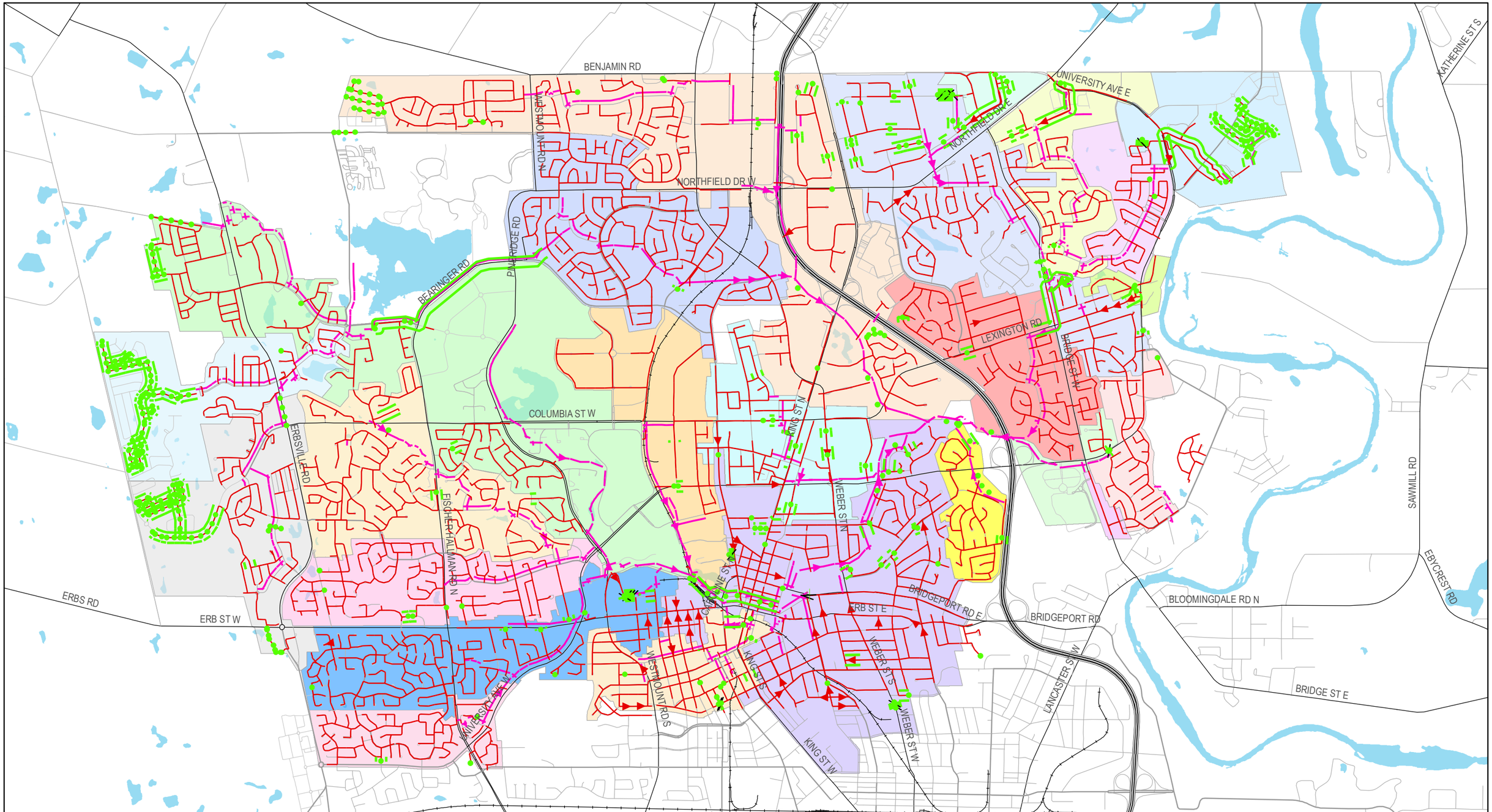
As indicated in Figure 4, clustered areas of missing data occur at the outskirts of the City. These are areas of recent or new development that may currently be in construction, As-Recorded drawings may be unavailable at this time, or data still needs to be transferred from As-Recorded drawings to the geodatabase. Additional locations with missing data are dispersed throughout the City, some occurring in small clusters, and some representing isolated data gaps.

In addition to missing elevations, conduit profile data was reviewed to identify:

- Bifurcation (i.e. flow split);
- Inconsistent profiles;
- Adverse (negative) or flat conduit slopes; and
- Conduits above the ground.

An important aspect of understanding the system hydraulics and connectivity is identifying how the many bifurcation (or flow split) locations operate. There are several location where multiple pipes discharge from the same manhole, particularly in the older parts of the collection system. These were historically designed to reduce the number of separate manholes needed, and often included specific benching, isolation measures, or pipe offsets within the manhole to direct flows in a primary location. As part of the data review, 114 locations were identified where incoming flow would possibly flow into two downstream sewers. The level of impact resulting from bifurcation locations is dependent on location and size of tributary drainage area.

Inconsistent profiles indicate sewers where the downstream invert (DOWNSTREAMIN) of the conduit upstream of a given manhole is lower than the upstream invert (UPSTREAMIN) of the conduit downstream of the same manhole (refer to Figure 5). In these cases, the manhole must surcharge in order for flow to be conveyed to the downstream sewer. Adverse or flat slopes also create circumstances in which sewers and/or manholes must surcharge in order to convey flow to the downstream sewer. Often, these cases represent an error in the data and impact the assessment of the sewer capacities.



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- Collector
- Highway
- Local

Sanitary Sewers
- Local Sewers
- Trunk Sewers
- Water Body
- Missing Invert Data
- Missing Diameter Data
- Missing Elevation
- Sanitary Sewershed

1611-11191

Figure No. 4

Title **MISSING PIPE AND MANHOLE DATA**

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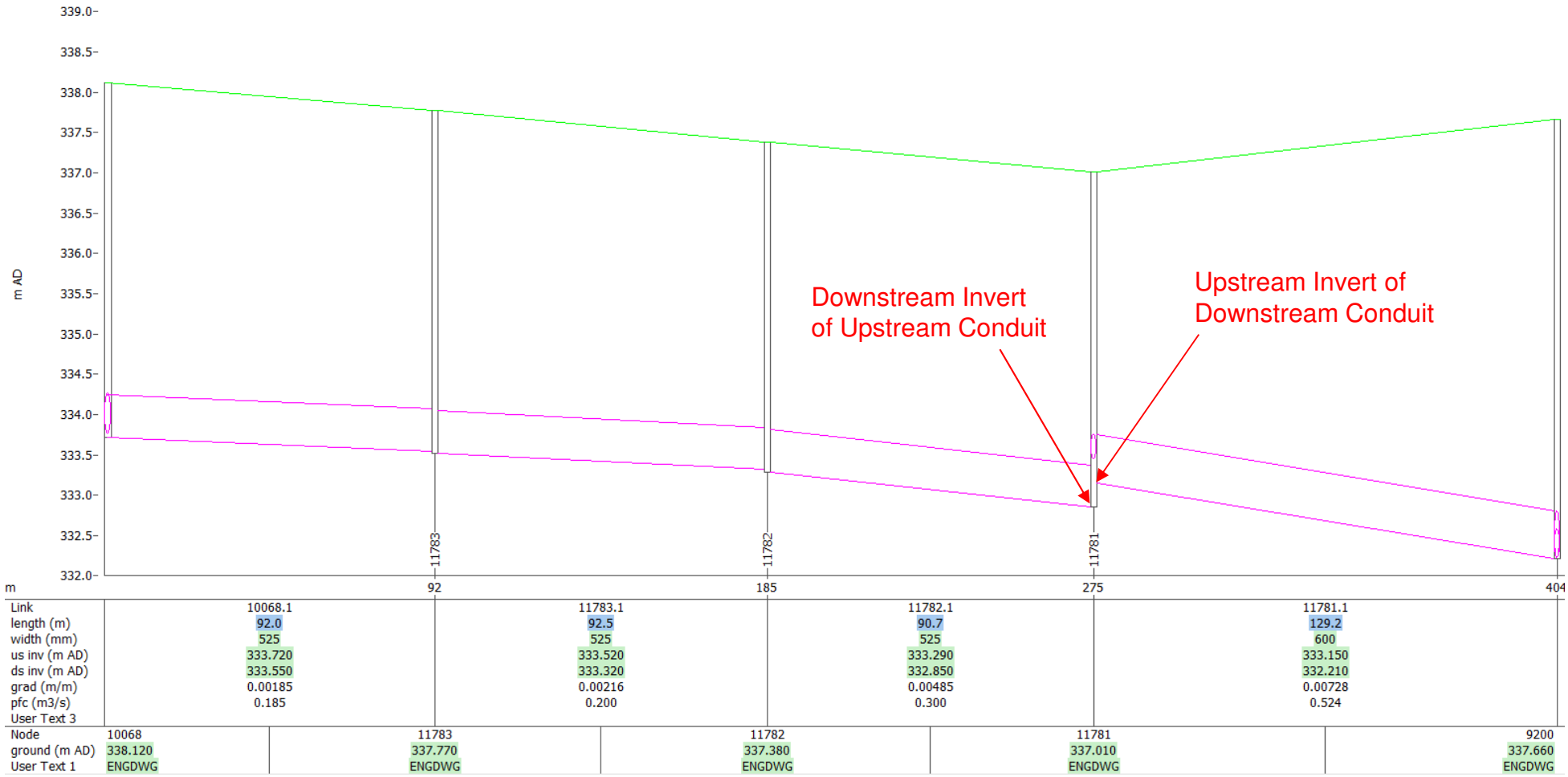

Link	10068.1	11783.1	11782.1	11781.1
length (m)	92.0	92.5	90.7	129.2
width (mm)	525	525	525	600
us inv (m AD)	333.720	333.520	333.290	333.150
ds inv (m AD)	333.550	333.320	332.850	332.210
grad (m/m)	0.00185	0.00216	0.00485	0.00728
pfc (m3/s)	0.185	0.200	0.300	0.524
User Text 3				

Node	10068	11783	11782	11781	9200
ground (m AD)	338.120	337.770	337.380	337.010	337.660
User Text 1	ENGDWG	ENGDWG	ENGDWG	ENGDWG	ENGDWG

October 2013
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Legend

Figure No. 5

Title **Inconsistent Profile Example**

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Waterloo Sanitary Servicing Master Plan

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Conduits flagged as having potential profile data errors and locations of bifurcation were also reviewed in the context of pipe diameter and the missing data described above. Figure 6 illustrates the potential profile data errors.

As shown in Figure 6, some potential profile errors are related to missing data. The remaining are cases in which data has been input and is suspect. An initial review of trunk sewers (based on the categorization indicated in the WSSS (AECOM, 2002)), was completed to plot individual profiles to review missing data and potential profile data errors. Trunk profiles are provided in Appendix A for reference.

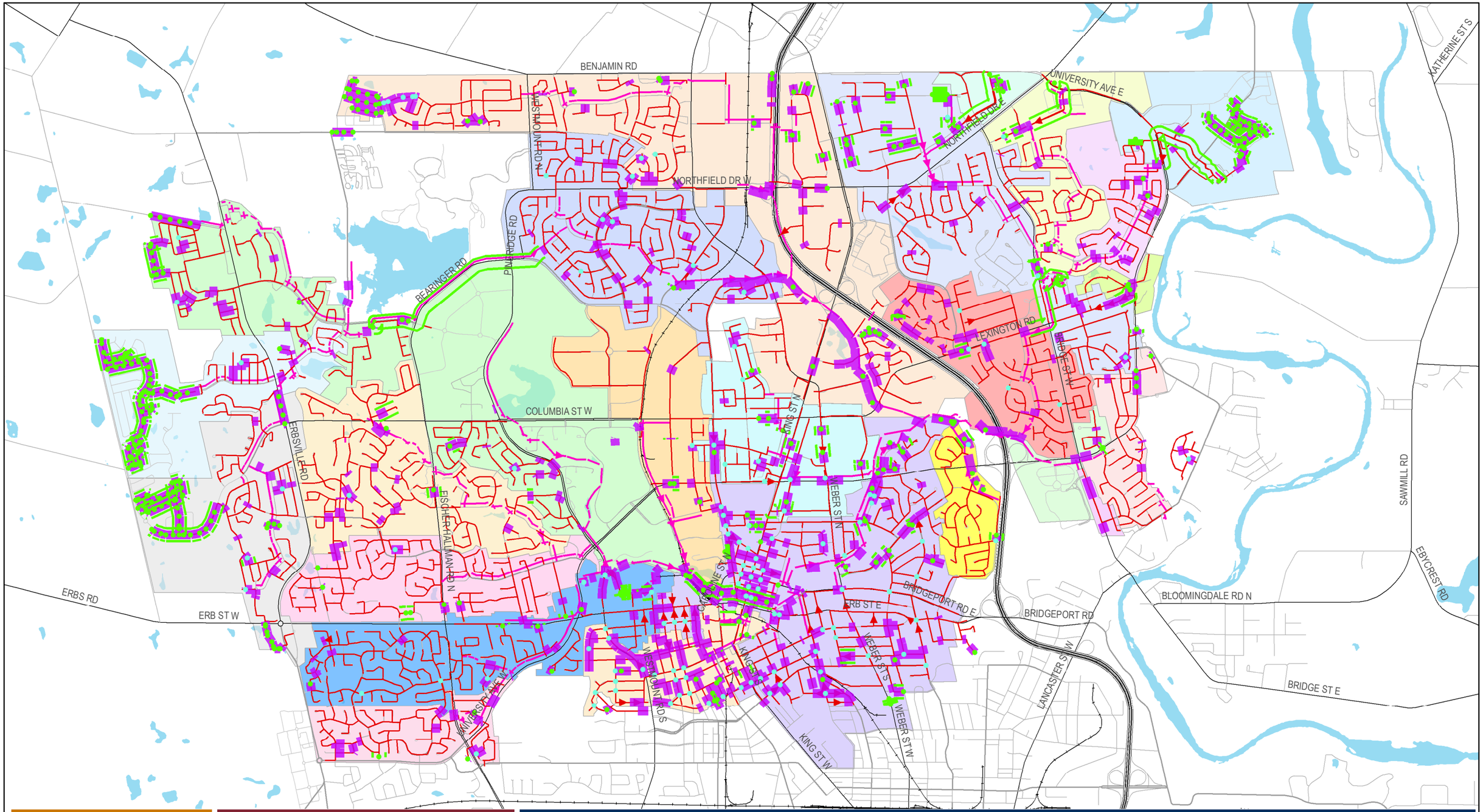
A summary of the missing data, potential profile errors, and locations of bifurcation throughout the sanitary system are provided in Table 6. Note that Table 6 summarizes information for active infrastructure only; proposed, private, temporary, or abandoned infrastructure was not included.

Table 6: Summary of Missing Data and Potential Concerns

Parameter	Structure Type	Number of Manholes	Number of Values	Percent Error
Elevation = Zero	Manhole	5,953	341	5.7%
Elevation = Blank	Manhole	5,953	51	0.9%
Elevation = "111.111"	Manhole	5,953	7	0.1%
Parameter	**Structure Type**	**Number of Manholes**	**Number of Uncertain Values**	**Percent Uncertain**
Bifurcation - Split Flow	All	5,953	114	1.9%
Parameter	**Structure Type**	**Number of Lines**	**Number of Missing or Zero Values**	**Percent Missing**
Diameter	Sewer Line	6,234	13	0.2%
Pipe Cross-Section Shape Unknown	Sewer Line	THERE IS NO SHAPE DATA - ASSUME CIRCULAR		
Upstream Invert	Sewer Line	6,234	205	3.3%
Downstream Invert	Sewer Line	6,234	202	3.2%
Parameter	**Structure Type**	**Number of Lines**	**Number of Uncertain Values**	**Percent Uncertain**
Lifecycle = Blank	All	6,234	126	2.0%
Adverse Slope	All	6,234	68	1.1%
Flat Slope	All	6,234	232	3.7%
Connectivity - SubNetworks	All	6,234	8	0.1%
Connectivity - GIS Length Mismatch	All	6,234	31	0.5%

Connectivity - Missing Downstream ID	All	6,234	49	0.8%
Invert Above Ground	All	6,234	337	5.4%
Soffit Above Ground	All	6,234	423	6.8%
Above Ground	All	6,234	518	8.3%
Inconsistent Profile	All	6,234	386	6.2%

In general, there are few missing or zero data entries in total, and a fairly low percentage of uncertain data points. However, given the size of the sewer portfolio, data uncertainties still represent a significant effort for confirmation and/or rectification.



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Legend

Transportation Network
- Arterial
- Collector
- Highway
- Local
- Water Body

Sanitary Sewers
- Local Sewers
- Trunk Sewers

Data Gap / Profile Uncertainty
- Manhole Bifurcation
- Missing Elevation
- Missing Invert Data
- Missing Diameter Data
- Inconsistent Profile

- Sanitary Sewershed

1611-11191

Figure No. 6

Title **OVERVIEW OF MISSING DATA AND POTENTIAL CONCERNS**

Client/Project CITY OF WATERLOO SANITARY SERVICING MASTER PLAN UPDATE

4.0 Quality Control Plan

Strategic correction and gap closure is required in order to proceed with the Master Planning process. The following outlines a proposed draft Quality Control Plan for conducting data corrections and gap closures on the City's Existing State geodatabase. An overview of the recommended approach is provided to prioritize, correct, and populate data for both the short-term need of the Master Plan, along with the long-term goal of a complete geodatabase update.

4.1 METHODOLOGY FOR DATA CORRECTIONS AND GAP CLOSURE

The long-term objective is to achieve as accurate a geodatabase as is possible, eliminating all uncertainties and gaps and maintaining the data as additions/changes are made to City infrastructure. However, given the number of uncertainties, inconsistencies and gaps within the City's Existing State geodatabase, a significant effort will be required to meet this end. Due to timing and budgetary constraints, a functional short-term goal is to update the Existing State geodata to reasonably represent the collection system in a hydraulic model for the purposes of Master Planning, while still identifying the need and plan for future data updates.

Data corrections and gap closures are typically completed by:

- Inferring data based on the surrounding network
- Obtaining information from available Engineering drawings
- Measuring data from topographic survey

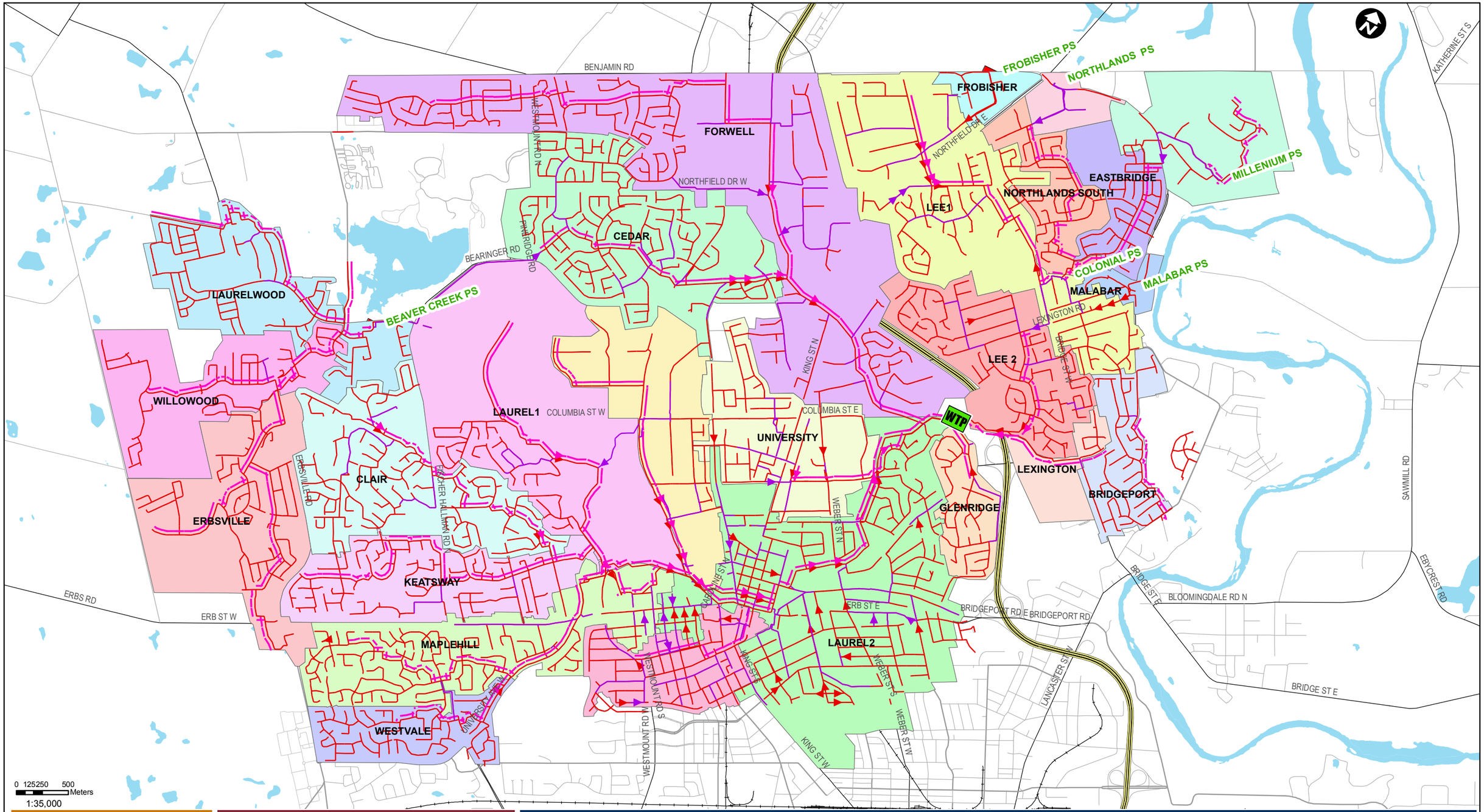
It is proposed that available Engineering drawings be used to verify data for areas that are considered a higher priority. If required, field work will be completed where feasible in higher priority areas where gaps or inconsistencies still exist after the drawing review has been completed. In lower priority areas or high priority areas where field work or drawing verification is not feasible, data will be inferred based on the surrounding network.

4.1.1 Prioritization for Data Verification

4.1.1.1 Sewer Prioritization

Sewers in the City's collection system were reviewed and categorized as trunk, subtrunk, or local sewers. Figure 7 illustrates the category assigned for each sewer.

Trunk sewers were identified based on a review of the WSSS (AECOM, 2002) and the Subtype coding provided in the 'City Existing State' geodatabase. Areas of discrepancies were noted between the two sources and minor adjustments were made based on our review of the surrounding network. The trunk categorization was based primarily on how the system operates rather than pre-defined criteria such as pipe diameter.



0 125250 500 Meters

1:35,000

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Legend

Transportation Network
- Arterial
- Collector
- Highway
- Local

- Water Body
- Existing Pump Station (PS)
- WTP — Wastewater Treatment Plant

- Trunk Sewer
- Subtrunk Sewer
- Local Sewer
- Sanitary Sewershed

1611-11191

Figure No. 7

Title **SEWER CATEGORIZATION**

Client/Project CITY OF WATERLOO SANITARY SERVICING MASTER PLAN UPDATE

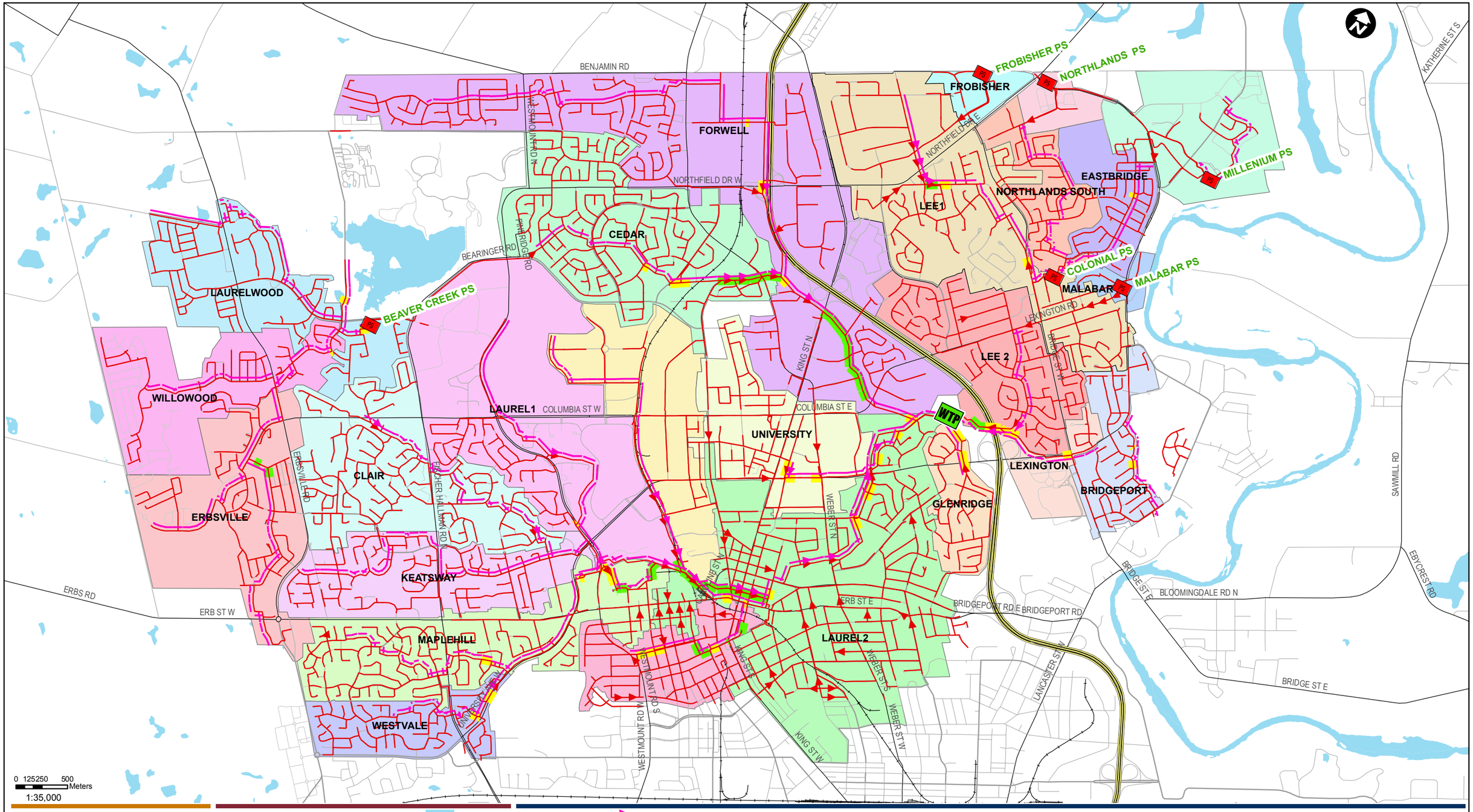
Subtrunk sewers were identified as those with a diameter of equal to or greater than 250 mm (11% of sewer system). Although 250 mm is not a large diameter, it provided a reasonable representation of the subtrunk sewers in the context of the City's collection system. The remaining sewers (pipes with a diameter less than 250 mm), were categorized as local sewers and represent approximately 74% of the overall sewer system.

The data gaps/uncertainties were initially reviewed based on the assigned sewer categories. Inherently, trunk sewers are critical to the collection system, as they have the potential to impact significant areas of the City. Therefore, missing/suspect data for trunk sewers were considered a high priority for review (Priority 1). Missing/suspect data for sub-trunk sewers were the next highest priority (Priority 2), and missing/suspect data for local sewers were assigned the lowest priority (Priority 3).

The initial review indicated a large number of data gaps and uncertainties for trunk and sub-trunk sewers (Priority 1 and Priority 2 infrastructure). As a result, a refined review was completed for Priority 1 and Priority 2 infrastructure to determine areas where data verification would be more beneficial. For example, if multiple adjacent sewers are missing invert information, drawing verification may be beneficial to evaluate system performance in this area with a reasonable level of confidence. This area would be assigned a higher priority. Alternatively, suspect data could be the result of a transcription error and could easily be reconciled based on the surrounding infrastructure. This area would be assigned a lower priority. Incorporating the results of the refined review resulted in the following categories for data verification:

- Priority 1A – Missing/suspect data for trunk sewer where data verification is a higher priority
- Priority 1B – Missing/suspect data for trunk sewer where data verification is a lower priority
- Priority 2A – Missing/suspect data for a subtrunk sewer where data verification is a higher priority
- Priority 2 – Missing/suspect data for a subtrunk sewer where data verification is a lower priority
- Priority 3 – Missing/suspect data for local sewer

Figure 8 and Figure 9 provide an overview of higher priority and lower priority infrastructure for Priority 1 and Priority 2 missing/suspect data, respectively.



Legend

Transportation Network
- Arterial
- Collector
- Highway
- Local

- Water Body
- Existing Pump Station
- Wastewater Treatment Plant
- Sanitary Sewershed

- Trunk Sewer
- Local Sewer
- Priority 1A (Higher Priority)
- Priority 1B (Lower Priority)

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Figure No. 8

Title **Overview of Priority 1 Infrastructure**

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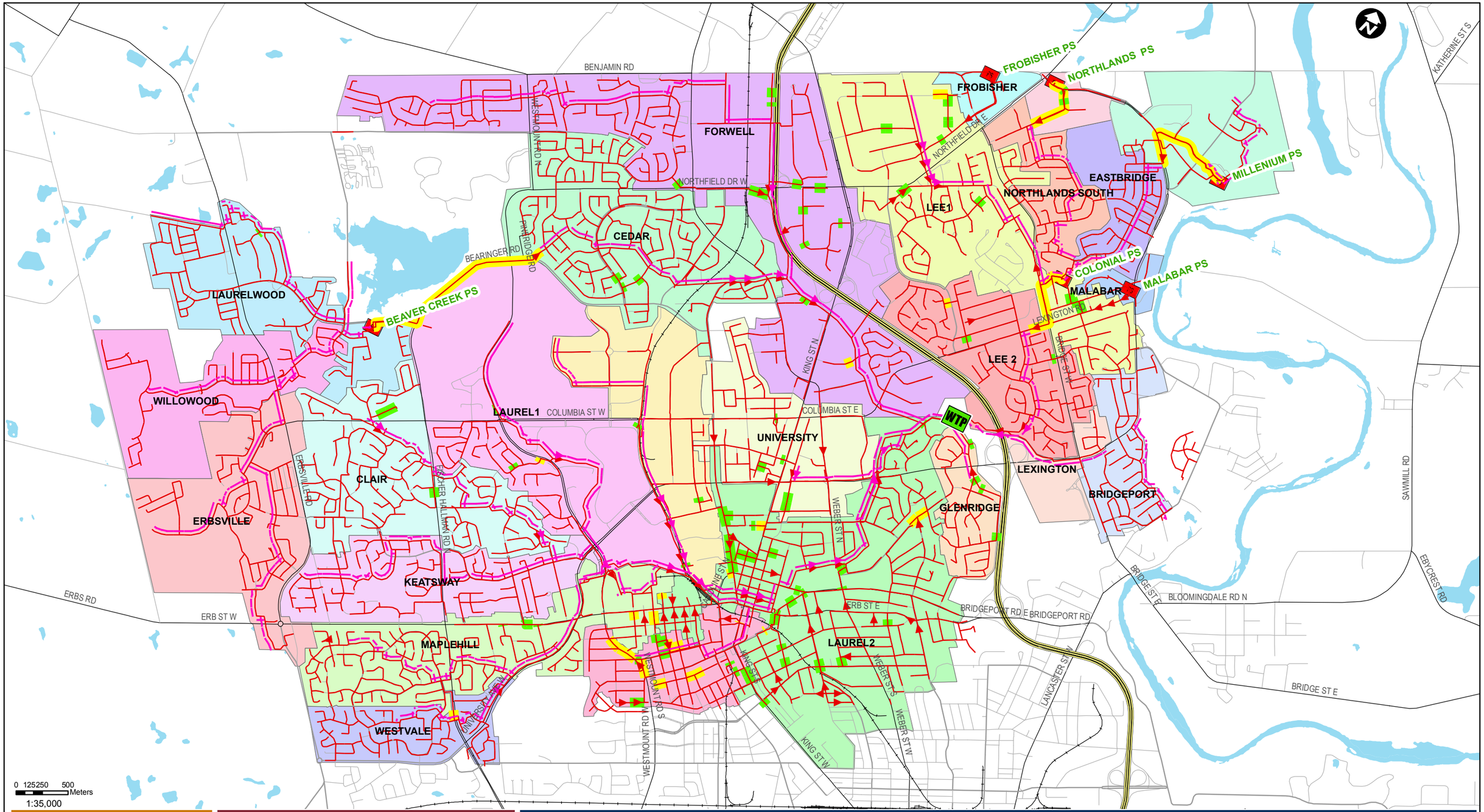

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Legend

Transportation Network
- Arterial
- Collector
- Highway
- Local

- Water Body
- Existing Pump Station
- Wastewater Treatment Plant
- Sanitary Sewershed

- Trunk Sewer
- Gravity Sewer

- Priority 2 - Proposed Data Inference
- Priority 2 - Proposed Drawing Review

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Figure No. 9

Title **Overview of Priority 2 Infrastructure**

Client/Project CITY OF WATERLOO SANITARY SERVICING MASTER PLAN UPDATE

4.1.1.3 Sewershed Prioritization

Sewersheds are defined based on how flow is routed through the collection system. The initial sewershed review indicated that updates were required to account for recent development and infrastructure data that has been incorporated into the geodatabase since the WSSS (AECOM, 2002). In addition, further refinement was introduced to represent the tributary drainage to each pump station. Figure 10 illustrates the sewersheds that were provided based on the WSSS (2002) and the revised sewersheds now proposed for the Master Plan. Additional revisions may be completed for sewersheds as data verification for the Master Plan is completed. Corrections to sewer inverts or confirmation of flow routing at bifurcation locations may impact the sewershed definitions.

The revised sewersheds were prioritized to provide additional considerations for optimizing the use of resources for data verification. A higher priority was assigned to sewershed where there is expected to be a significant increase in future flows. Priorities were assigned based on:

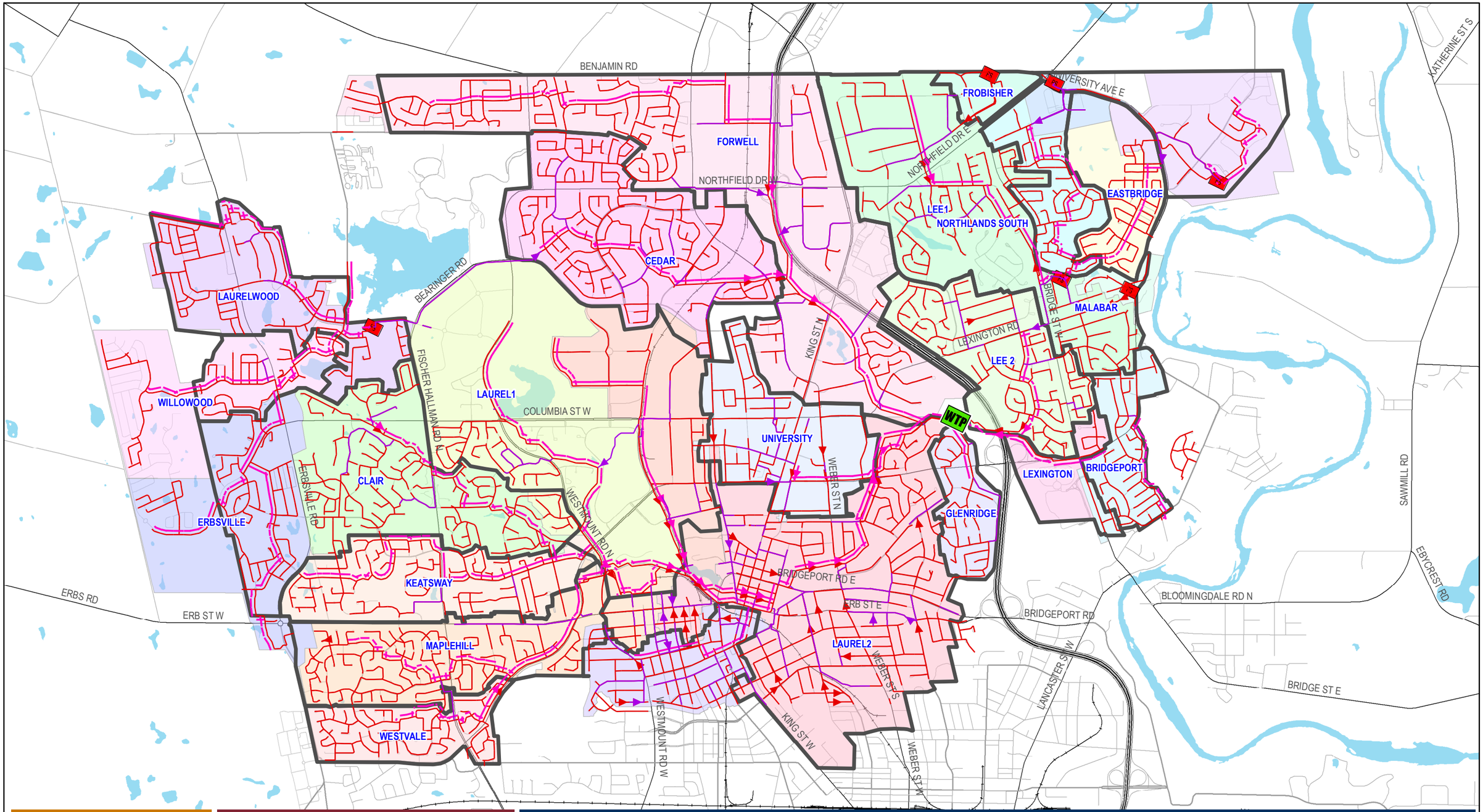
- Preliminary development information (2011-2014 Staging and Development Program, April 2011)
- Intensification areas
- Potential locations receiving external flows in the future

Figure 11 illustrates the sewershed priorities. These priorities will be used in conjunction with the sewer priorities to optimize the allocation of resources.

4.1.2 Data Extent

The City's geodatabase is constantly being updated and for new development, there is a lag between sewer construction and receipt of as-recorded drawings and subsequent update in GIS. Therefore, several gaps are associated with new development. Here, it is understood that this information complete with reliable topographically surveyed data will eventually be provided, therefore for the Master Plan it is recommended that this infrastructure be excluded from the gap closure exercise to focus on areas of greater importance. Flows generated from these areas will be represented as a point load where the areas connect to existing infrastructure.

The same approach is recommended for areas in the City of Kitchener, such as the Kiwanis neighbourhood, that impact Waterloo's collection system but are not located within the City. By excluding areas that are not in the City of Waterloo and newer areas that are highly unlikely to have capacity constraints, resources can be focused on confirming data and closing gaps in more critical areas of the collection system, such as trunk sewers, subtrunk sewers, and older sewers subject to intensification. Proposed areas to be excluded in the initial modeling are illustrated in Figure 12.



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Legend

Transportation Network
- Arterial
- Collector
- Highway
- Local

- Water Body
- Trunk Sewer
- Subtrunk Sewer
- Local Sewer
- Sewersheds (c. 2002)

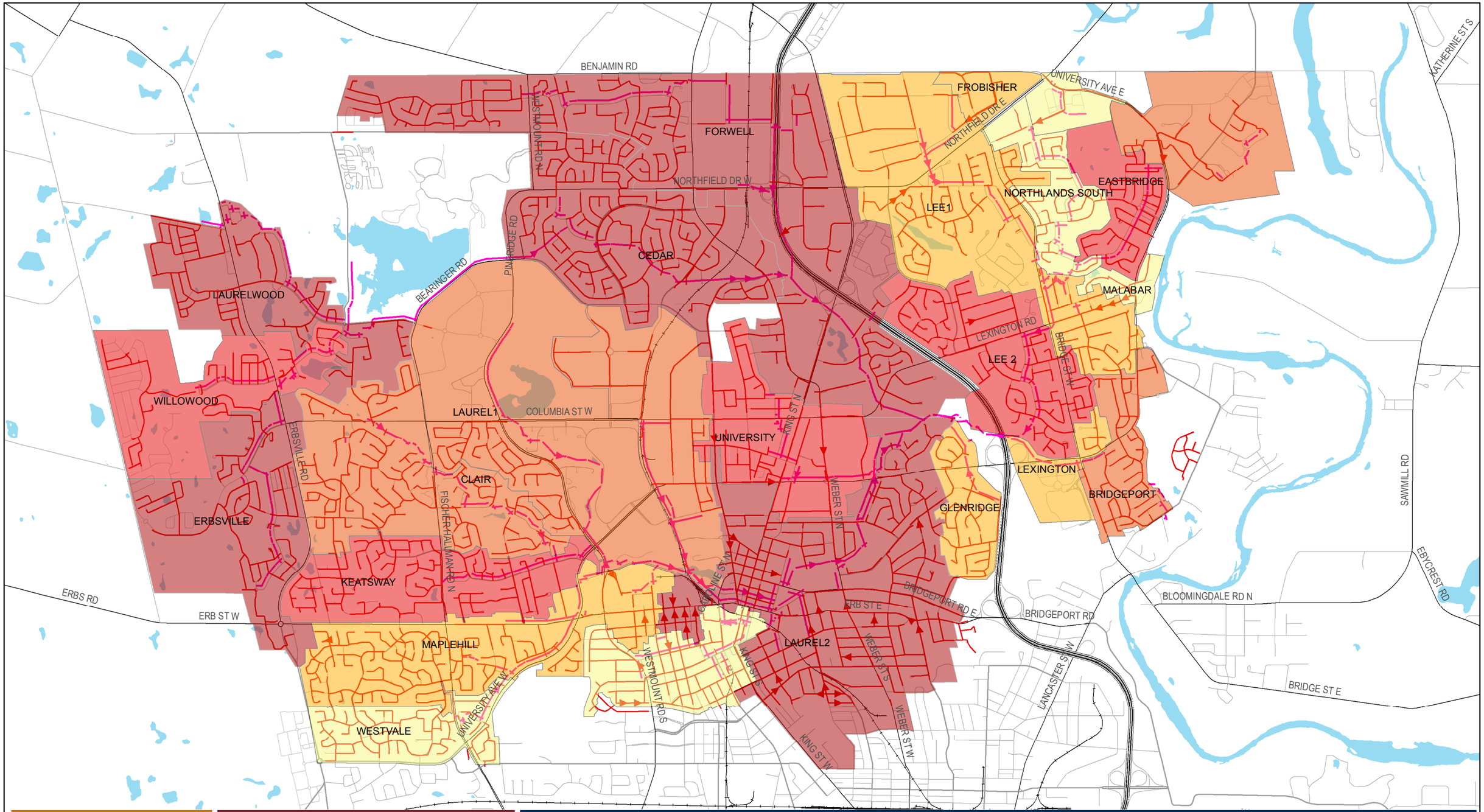
- Revised Sanitary Sewershed

1611-11191

Figure No. 10

Title **REVISED SEWERSHEDS**

Client/Project CITY OF WATERLOO SANITARY SERVICING MASTER PLAN UPDATE



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Legend

Transportation Network
- Arterial
- Collector
- Highway
- Local

Water Body

Sanitary Sewers
- Local Sewers
- Trunk Sewers

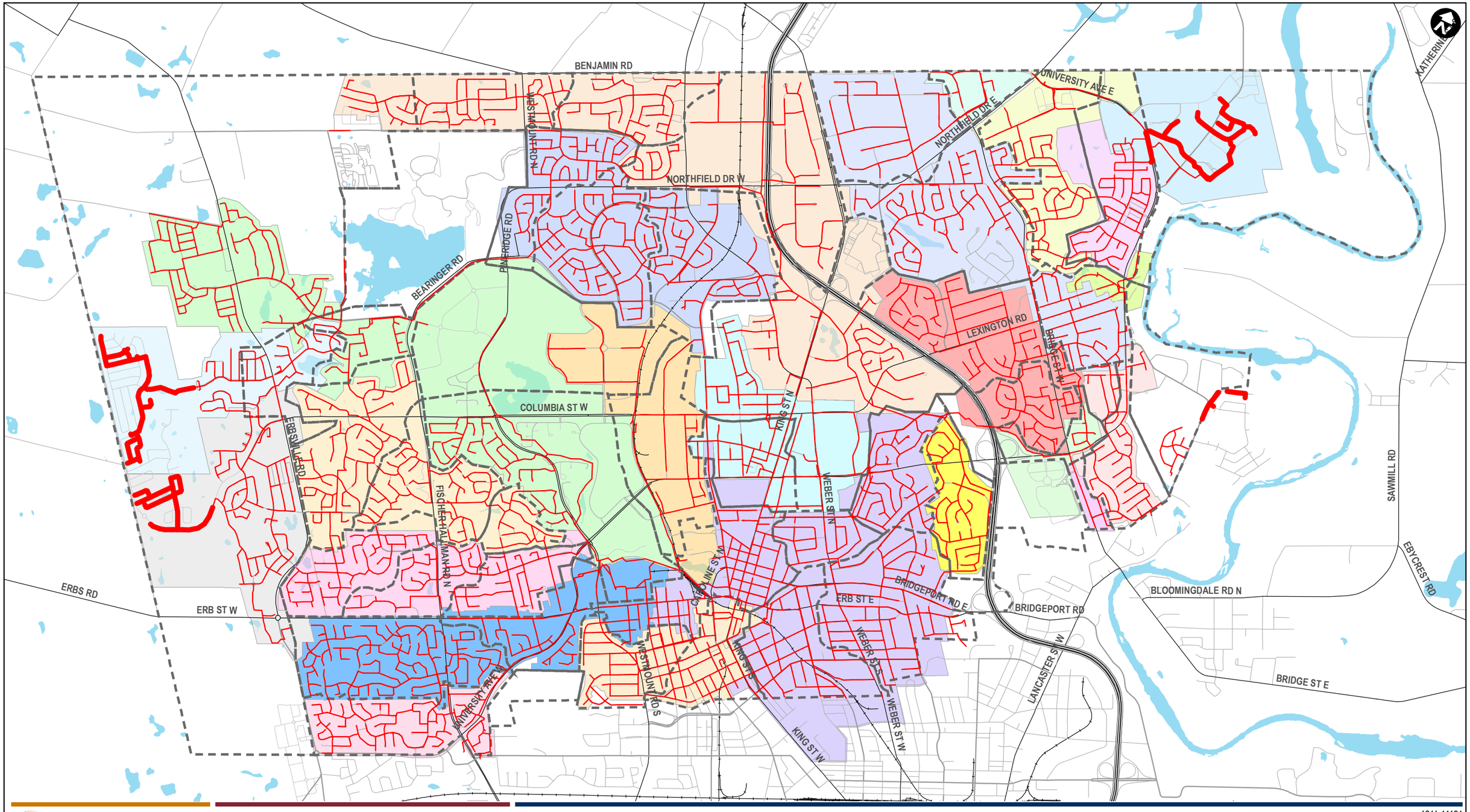
Sewershed Priority
- Higher
- Lower

1611-11191

Figure No. 11

Title **SEWERSHED PRIORITIZATION**

Client/Project CITY OF WATERLOO SANITARY SERVICING MASTER PLAN UPDATE



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Legend

Transportation Network
- Arterial
- Collector
- Highway
- Local

- Sewers
- Sewers to be Excluded
- Extent of 2002 Modeled Subcatchments
- Water Body
- Sanitary Sewersheds

1611-11191

Figure No. 12

Title **AREAS TO BE EXCLUDED FROM INITIAL MODELING**

Client/Project CITY OF WATERLOO SANITARY SERVICING MASTER PLAN UPDATE

4.1.4 Data Verification for Manholes

4.1.4.1 Ground Elevations

Missing top of manhole elevations can be initially estimated based on contour elevations, unless doing so would create a profile error. Although there may be some small discrepancies between contour elevations and the finished grade of the manholes, the difference is considered acceptable for the purpose of developing a hydraulic model for capacity assessments.

4.1.4.2 Bifurcation

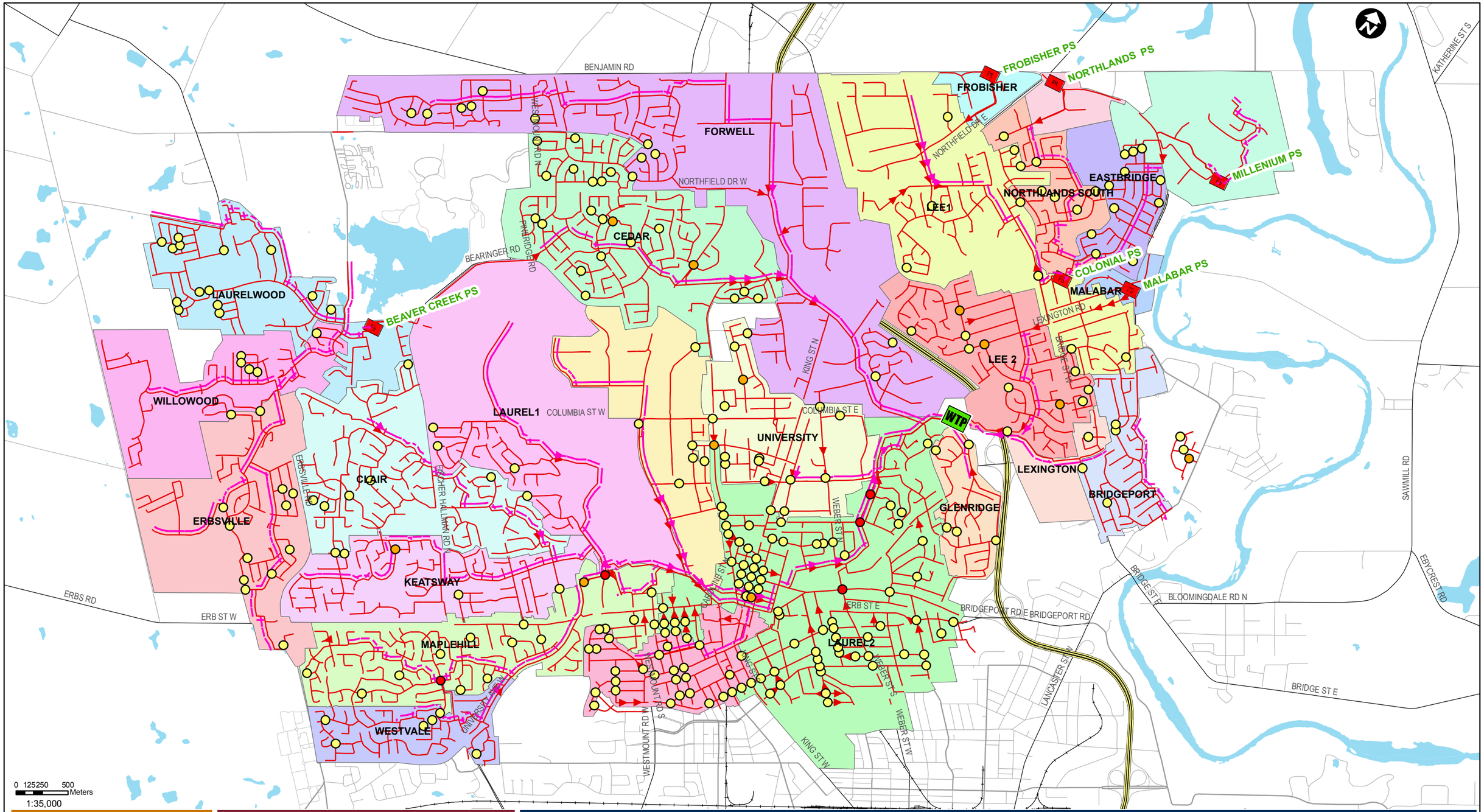
Locations of bifurcation were reviewed based on the upstream collection area. Bifurcations were flagged as high, moderate, or low priority levels for follow up. There was some uncertainty in the level of impact for bifurcation locations in the older areas of the collection system, such as the Laurel2 and William sewersheds, due to the degree of pipe interconnectivity. As a result, the extent of the upstream collection areas cannot be definitively defined.

Figure 13 illustrates the priorities assigned for bifurcation locations. Overall, the majority of the bifurcation locations were identified as low priority for follow-up. The upstream collection areas were small and would impact small localized areas. Approximately 10 locations were identified as moderate priorities as a result of larger collection areas or the potential to impact flows in trunk sewers. Five (5) locations were identified as high priority for follow-up. The routing of flow at these five locations will significantly impact the collection system based on large upstream collection areas, conveying flow through trunk sewers, and conveying flow between sewersheds.

4.1.5 Data Verification for Sewers

Data verification will be completed for sewers primarily based on sewer prioritizations. Consideration for sewershed priorities will be used to determine the sequence of review for infrastructure within the same sewer priority.

Data verification for Priority 1 infrastructure will begin with a review of available engineering drawings. If required, field work will be completed after the drawing review for remaining missing and suspect data where possible. In some cases, it may not be feasible to verify data based on field investigation without confined space entry. Confined space entry will be required if the depth of sewer is greater than the survey rod or the sewer connections are not visible with a camera pole. If data verification is not feasible through drawing review or field work, data will be inferred. It is estimated that the majority of the allocated resources for drawing review and field work will be used to verify missing/suspect data for Priority 1 infrastructure.



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Legend

Transportation Network
- Arterial
- Collector
- Highway
- Local

- Water Body
- Existing Pump Station
- Wastewater Treatment Plant
- Sanitary Sewershed

- Trunk Sewer
- Local Sewer

Bifurcation Locations
- High Priority
- Moderate Priority
- Low Priority

1611-11191

Figure No. 13

Title **BIFURCATION LOCATIONS**

Client/Project CITY OF WATERLOO SANITARY SERVICING MASTER PLAN UPDATE

Data verification for Priority 2 infrastructure will primarily include inferring data based on the surrounding network. If there are allocated resources remaining after missing and suspect data are verified for Priority 1 infrastructure, it is proposed that drawings be reviewed for Priority 2A infrastructure. As described in Section 4.1.1.1, Priority 2A infrastructures are areas where it would be more difficult to infer data and maintain a reasonable level of confidence.

Data verification for Priority 3 infrastructure will include inferring data as required based on the surrounding network. These are considered to have small areas of impact on the overall system, and inferred data can be field or drawing verified in the future as the City progresses toward its goal for a complete geodatabase update. The extent to which data will be inferred for Priority 3 infrastructure is dependent on the model needs. Only sewers that are to be included in the hydraulic model will require data verification for the purposes of the Master Plan. For example, if a trunk level model is preferred, all local sewers will be excluded from the model and no data will need to be inferred for Priority 3 infrastructure. Alternatively, if an all pipe model is preferred, all local sewers will be included in the model and all missing/suspect data will need to be inferred for Priority 3 infrastructure.

4.2 METHODOLOGY FOR DATA UPDATES

For transparency and ease of cross-checking, all revised data will be coded in a new series of fields to distinguish what is recommended for change versus the original data. This will allow the City an opportunity to agree, disagree, and/or modify the recommendations made by Stantec. Table 7 summarizes the proposed fields to be added to the geodatabase.

Table 7: Proposed Geodatabase Fields for Documenting Updates

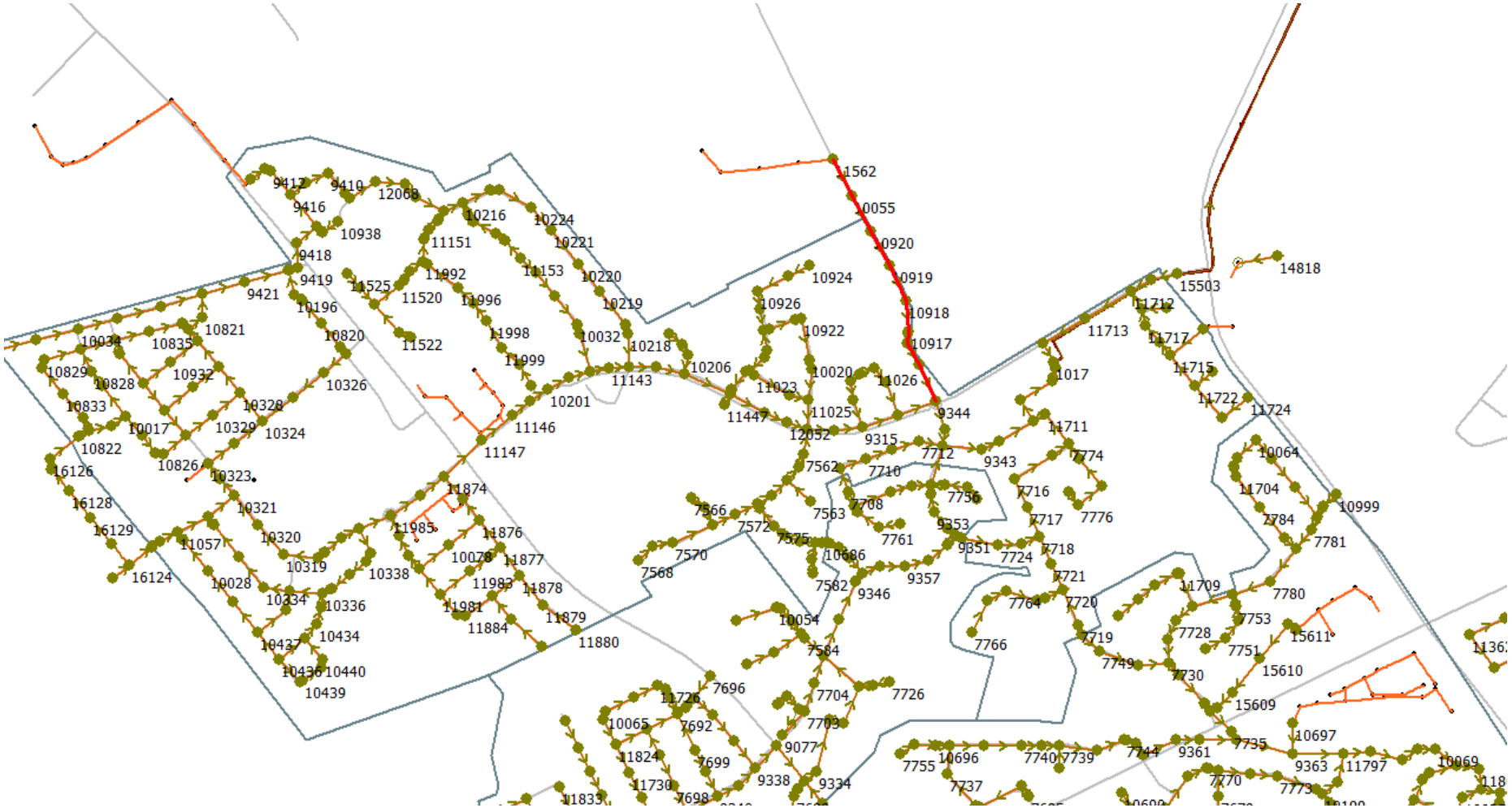
Field Heading	Field Name	Description
MP13_Loc	Master Plan 2013 Location Change	Indicate if the spatial position of a manhole or pipe has been updated.
MP13_XYPos	Master Plan 2013 Position Change	Indicate how the location of a pipe or manhole was updated (i.e. GPS, Total Station, Engineering Drawings, etc.)
MP13_ZAcc	Master Plan 2013 Accuracy	Indicate how z values were updated (i.e. field verified, interpolated, etc.)
MP13_UpInv	Master Plan 2013 Upstream Invert Change	Indicate the updated upstream invert
MP13_UpInvS	Master Plan 2013 Upstream Invert Data Source	Indicate the source of the upstream invert data
MP13_DowIn	Master Plan 2013 Downstream Invert Change	Indicate the updated downstream invert
MP13_DSInvS	Master Plan 2013 Upstream Invert Data Source	Indicate the source of the downstream invert data

Field Heading	Field Name	Description
MP13_Diam	Master Plan 2013 Diameter Change	Indicate the updated pipe diameter
MP13_DiamS	Master Plan 2013 Diameter Data Source	Indicate the source of the pipe diameter
MP13_FlVer	Master Plan 2013 Field Verified	Indicate all manholes and pipes that have been field verified, even if no attributes are updated.
MP13_ToMH	Master Plan 2013 From Manhole Change	Indicate the new upstream manhole
MP13_FromMH	Master Plan 2013 To Manhole Change	Indicate the new downstream manhole
MP13_TopMH	Master Plan 2013 Top of Manhole Change	Indicate new top of manhole
MP13_TopMHS	Master Plan 2013 Top of Manhole Source	Indicate source of top of manhole
MP13_Notes	Master Plan 2013 Notes	Indicate any other information that may be useful when transferring data between Stantec and the City.
Data Source Codes: AR - as recorded drawing; AD - as designed drawing; FD - field measured by dip; FS - field measured by survey rod; IF - inferred based on surrounding infrastructure; TV - from CCTV measurement; OT - other, clarify in notes; EX - no change to existing geodata		

Recommendations are to be provided to the City for a single sewershed area to allow an opportunity to review and integrate the data for one area and confirm this is the preferred approach. If the initial data transfer is successful, recommendations are to be provided for the remaining network using the same approach. If the initial transfer is unsuccessful, Stantec will discuss potential modifications to the methodology with City staff to improve the integration of data.

Upon completion of data integration, an updated geodatabase, referred to as the Current State geodatabase, will be issued to Stantec. The Current State geodatabase will be used for developing a hydraulic model in accordance with Task 4.

Appendix A:
Review of Trunk Profiles



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Drawing is not to be used for construction

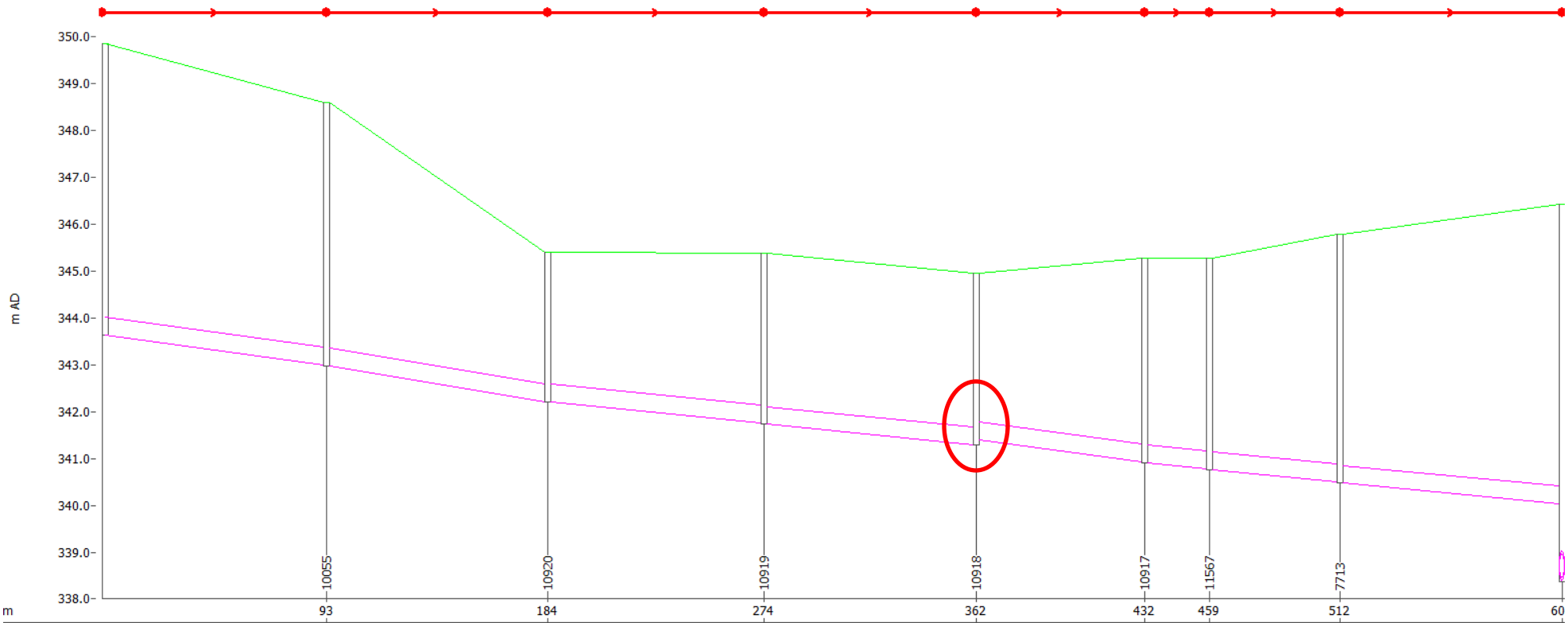
Legend

Figure No. 1

Title **Beaver Creek Trunk Geoplan Overview**

Client/Project City of Waterloo

Waterloo Sanitary Servicing Master Plan



Link	11562.1	10055.1	10920.1	10919.1	10918.1	10917.2	11567.1	7713.1
length (m)	93.1	91.3	89.9	87.6	69.8	26.9	53.9	91.9
width (mm)	375	375	375	375	375	375	375	375
us inv (m AD)	343.644	342.975	342.215	341.735	341.402	340.910	340.760	340.480
ds inv (m AD)	343.005	342.215	341.765	341.298	340.940	340.790	340.510	340.042
grad (m/m)	0.00686	0.00833	0.00501	0.00499	0.00661	0.00447	0.00464	0.00477
pfc (m3/s)	0.145	0.160	0.124	0.124	0.143	0.117	0.119	0.121
User Text 3	Active		Active	Active	Active	Active	Active	Active

Node	11562	10055	10920	10919	10918	10917	11567	7713	9344
ground (m AD)	349.868	348.611	345.400	345.390	344.950	345.270	345.270	345.782	346.434
User Text 2	Active	Active	Active	Active	Active	Active	Active	Active	Active

July 2013

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Drawing is not to be used for construction

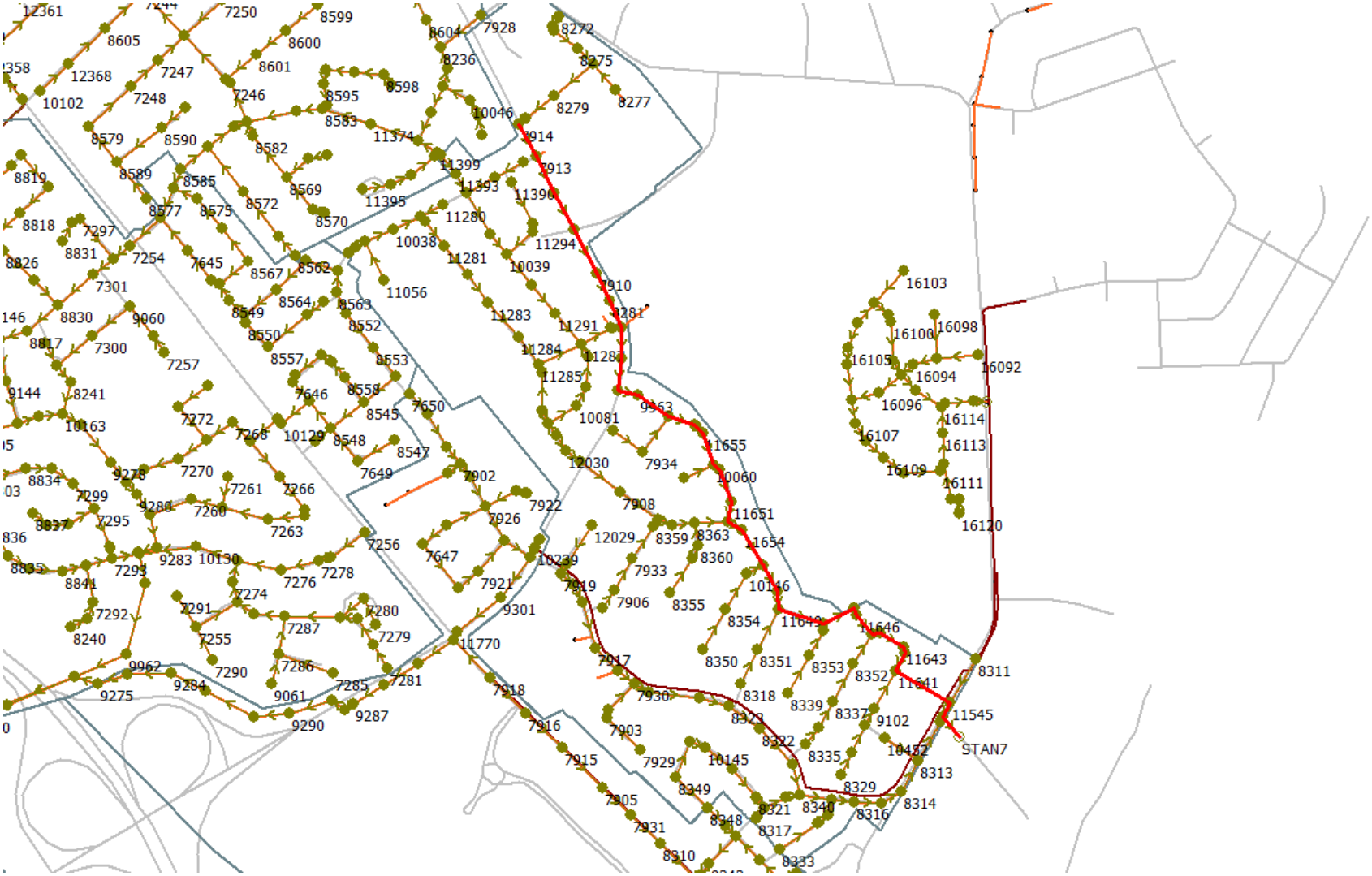
Legend

Figure No. 1

Title **Beaver Creek Trunk – Profile**

Client/Project City of Waterloo

Waterloo Sanitary Servicing Master Plan



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Legend

Figure No. 1

Title **Bridgeport Trunk Geoplan Overview**

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49 Frederick Street
Kitchener, Ontario, Canada
N2H 6M7
Tel: (519) 579-4410
Fax: (519) 579-6733
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Waterloo Sanitary Servicing Master Plan

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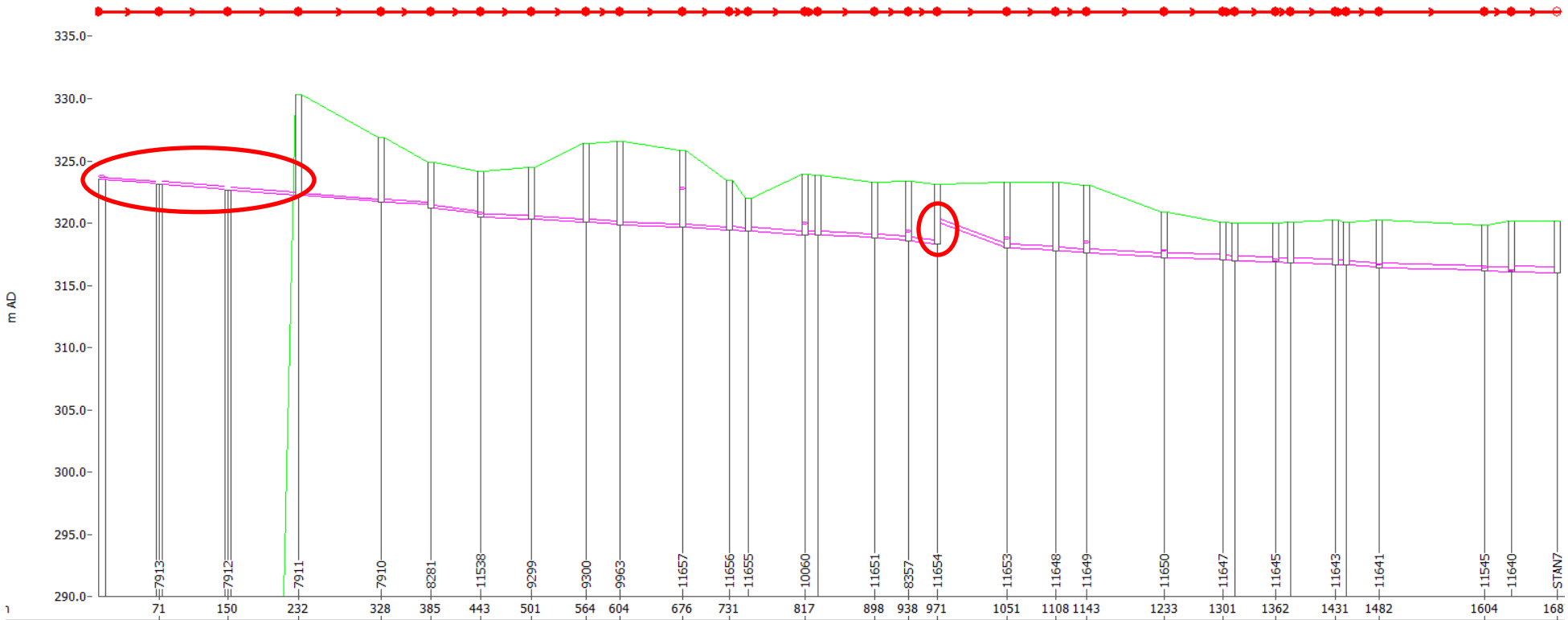

	71	150	232	328	385	443	501	564	604	676	731	817	898	938	971	1051	1108	1143	1233	1301	1362	1431	1482	1604	168						
Link	7914.1	7913.1	7912.1	7911.1	7910.1	8281.1	11538.1	9299.1	-	9963.1	11657.1	-	11655.1	-	11652.1	-	-	11654.1	11653.1	-	11649.1	11650.1	-	-	-	-	11641.1	-	11640.1			
length (m)	71.1	79.3	81.7	95.6	57.1	58.0	58.7	62.7	39.7	72.1	54.5	-	65.1	-	65.6	39.5	33.3	79.8	56.9	35.1	90.7	67.4	46.7	-	52.2	38.2	122.2	30.8	52.8			
width (mm)	200	200	200	200	200	200	250	250	250	250	250	-	300	-	300	300	300	300	300	300	300	375	375	-	375	375	375	375	450			
us inv (m AD)	323.510	323.150	322.675	322.213	321.717	321.234	320.522	320.304	-	319.869	319.667	-	319.370	-	319.060	-	-	320.010	318.050	-	317.608	317.229	-	-	-	-	316.430	-	316.090			
ds inv (m AD)	323.180	322.740	322.268	321.732	321.521	320.781	320.364	320.062	-	319.667	319.465	-	319.083	-	318.870	-	-	318.090	317.870	-	317.304	317.137	-	-	-	-	316.230	-	316.030			
grad (m/m)	0.00464	0.00517	0.00498	0.00503	0.00343	0.00781	0.00269	0.00386	-	0.00280	0.00370	-	0.00441	-	0.00290	-	-	0.02406	0.00316	-	0.00335	0.00136	-	-	-	-	0.00164	-	0.00114			
pfc (m3/s)	0.022	0.024	0.023	0.023	0.019	0.029	0.031	0.037	0.033	0.031	0.036	-	0.064	-	0.052	0.058	-	0.150	0.054	-	0.056	0.065	0.072	-	0.066	0.120	0.071	-	0.096			
User Text 3	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	-	Active	-	Active	Active	-	Active	Active	-	Active	Active	Active	-	Active	-	Active	-	Active			
Node	-	7913	7912	7911	7910	8281	11538	9299	9300	9963	11657	-	-	-	-	11651	-	11654	11653	-	11649	11650	-	-	-	-	-	11641	11545	-	-	
ground (m AD)	-	111.111	111.111	330.347	326.890	-	-	324.501	-	-	325.830	-	-	-	-	-	-	-	323.275	-	323.080	320.930	-	-	-	-	-	320.292	319.859	-		
User Text 2	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	-	-	-	-	Active	-	Active	Active	-	Active	Active	-	-	-	-	-	Active	Active	-		

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Figure No. 1

Title **Bridgeport Trunk Profile**

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Waterloo Sanitary Servicing Master Plan

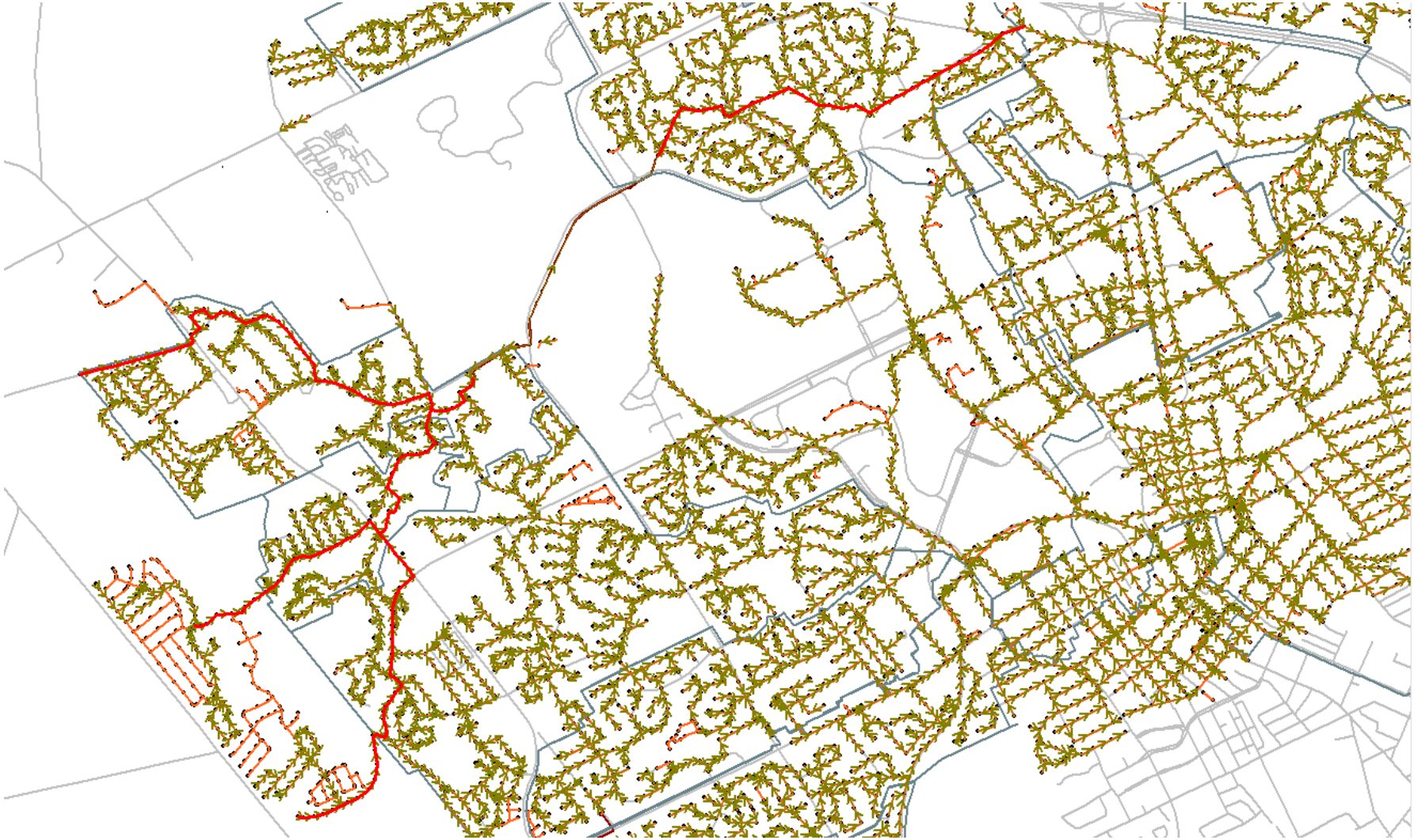

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Figure No. 1

Title **Cedar Trunk Geoplan Overview**

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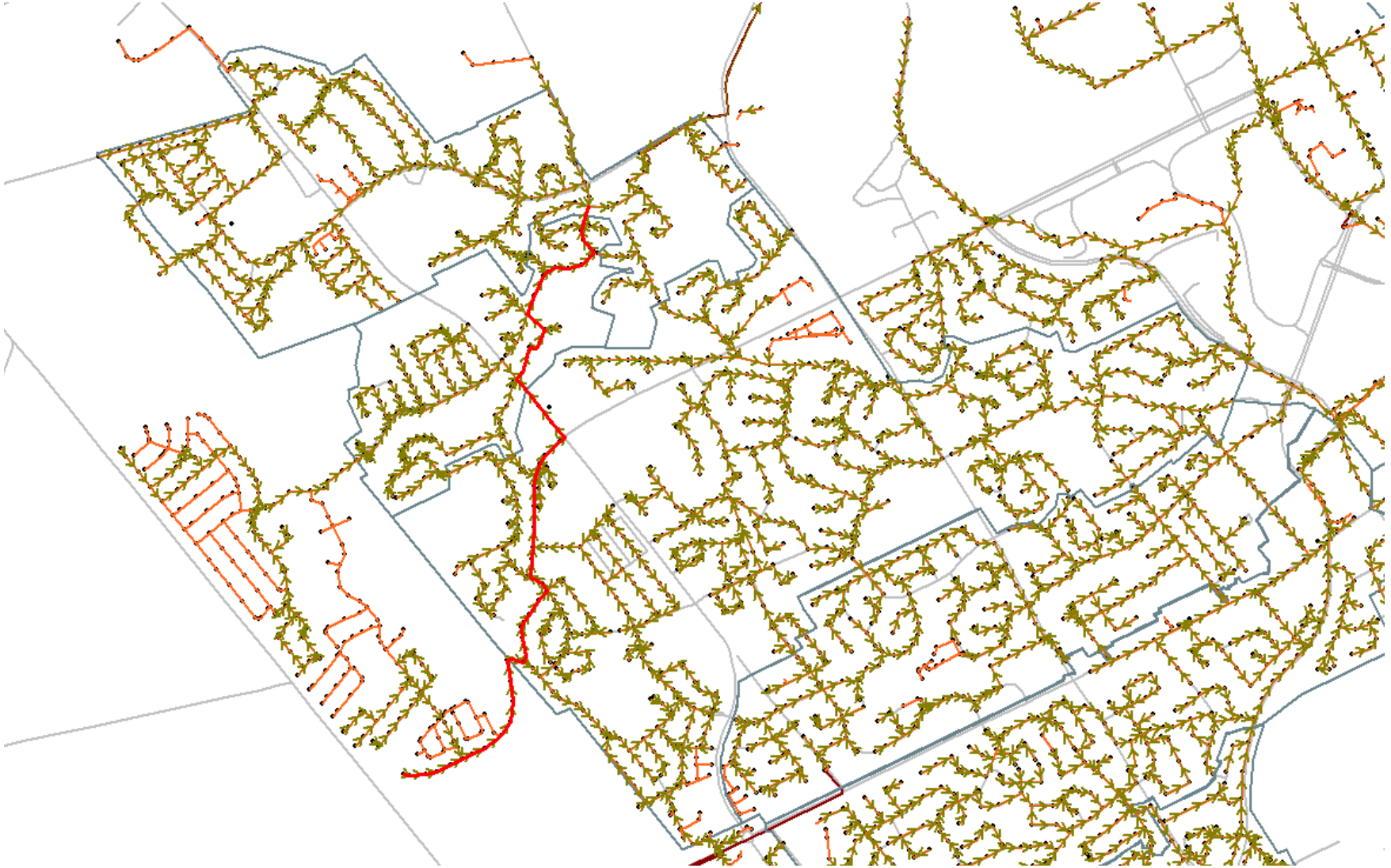

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Figure No. 1

Title **Cedar Trunk 1 – Profile Overview**

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Waterloo Sanitary Servicing Master Plan

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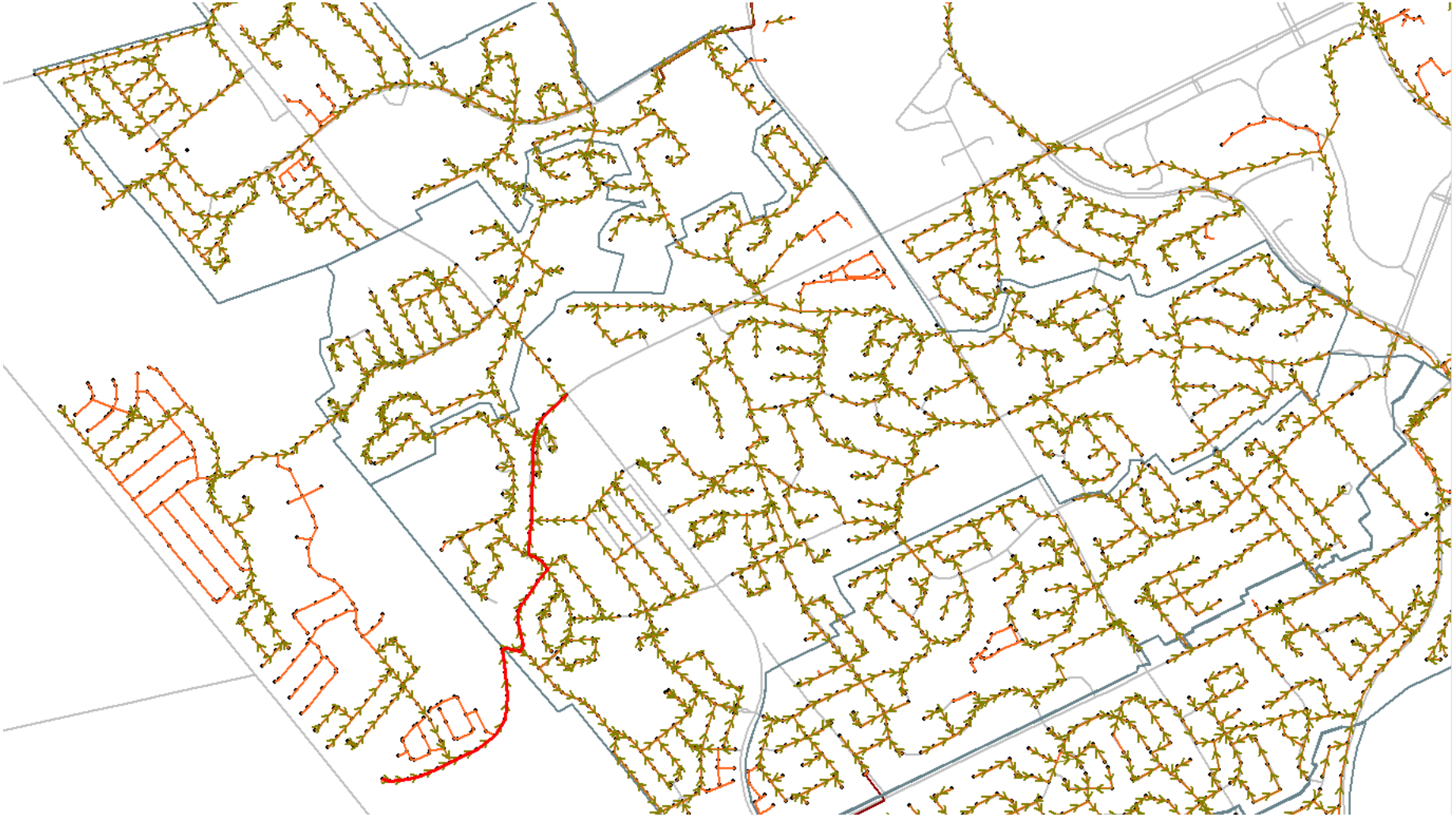

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Figure No. 1

Title **Cedar Trunk 1 – Profile 1 Overview**

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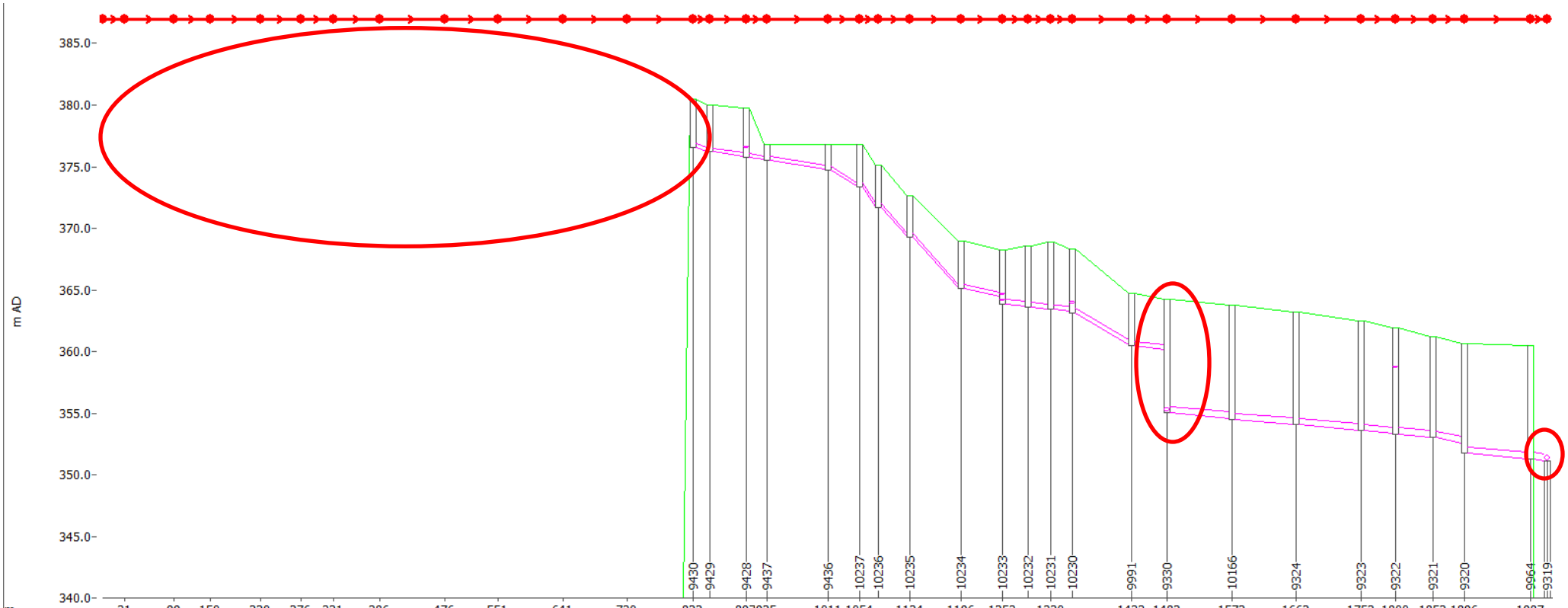

m	31	99	150	220	276	321	386	476	551	641	730	822	897	925	1011	1054	1124	1196	1253	1320	1433	1482	1572	1662	1752	1800	1852	1896	1987
Link	-	15860.1	-	15876.1	-	-	15873.1	15872.1	15866.1	15867.2	15868.1	16091.1	-	-	-	9437.1	-	-	-	10235.1	-	-	-	-	10230.1	-	9330.1	10166.1	9324.1	-	-	-	9320.1	-
length (m)	-	68.8	50.2	70.0	56.7	44.8	65.3	89.5	74.6	90.2	89.5	91.5	-	50.8	-	85.1	43.8	-	43.9	71.2	57.6	35.8	-	-	83.2	48.9	90.0	90.0	90.0	47.8	52.5	44.0	91.3	-
width (mm)	200	200	200	200	200	300	300	300	300	300	300	300	-	300	300	300	300	-	300	300	300	375	375	375	375	375	525	525	525	525	525	525	525	-
us inv (m AD)	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.000		-	-	-	375.538	-	-	-	369.291	-	-	-	-	363.133	-	355.058	354.478	354.098	-	-	-	351.780	-
ds inv (m AD)	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.000		-	-	-	374.793	-	-	-	365.193	-	-	-	-	360.612	-	354.608	354.128	353.648	-	-	-	351.330	-
grad (m/m)	-	0.00000	-	0.00000	-	-	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-	-	-	0.00875	-	-	-	0.05755	-	-	-	-	0.03029	-	0.00500	0.00389	0.00500	-	-	-	0.00493	-
pfc (m3/s)	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-	0.084	-	0.090	0.168	-	0.224	0.232	0.102	-	-	-	0.305	0.137	0.304	0.268	0.304	0.305	0.304	0.435	0.302	-
User Text 3	-	Active	Active	Active	Active	-	Active	Active	Active		Active		-	Active	-	Active	-	-	-	Active	Active	-	-	-	Active	Active	Active	Active	Active	Active	Active	-	Active	-
Node	-	15877	15876	15875	-	-	15872	15866	15867	15868	16091	9430	-	-	-	9437	9436	-	-	10235	10234	-	-	-	-	9991	9330	10166	9324	9323	9322	9321	9320	9964	
ground (m AD)	-	0.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	363.743	363.202	-	-	-	-	-	
User Text 2	-	Active	Active	Active	-	-	Active	Active	Active	Active	Active	Active	-	-	Active	Active	-	-	Active	Active	-	-	-	Active	Active	Active	Active	Active	Active	-	-	Active	Active	

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Figure No. 1

Title **Cedar Trunk 1 – Profile 1**

Client/Project City of Waterloo

Waterloo Sanitary Servicing Master Plan

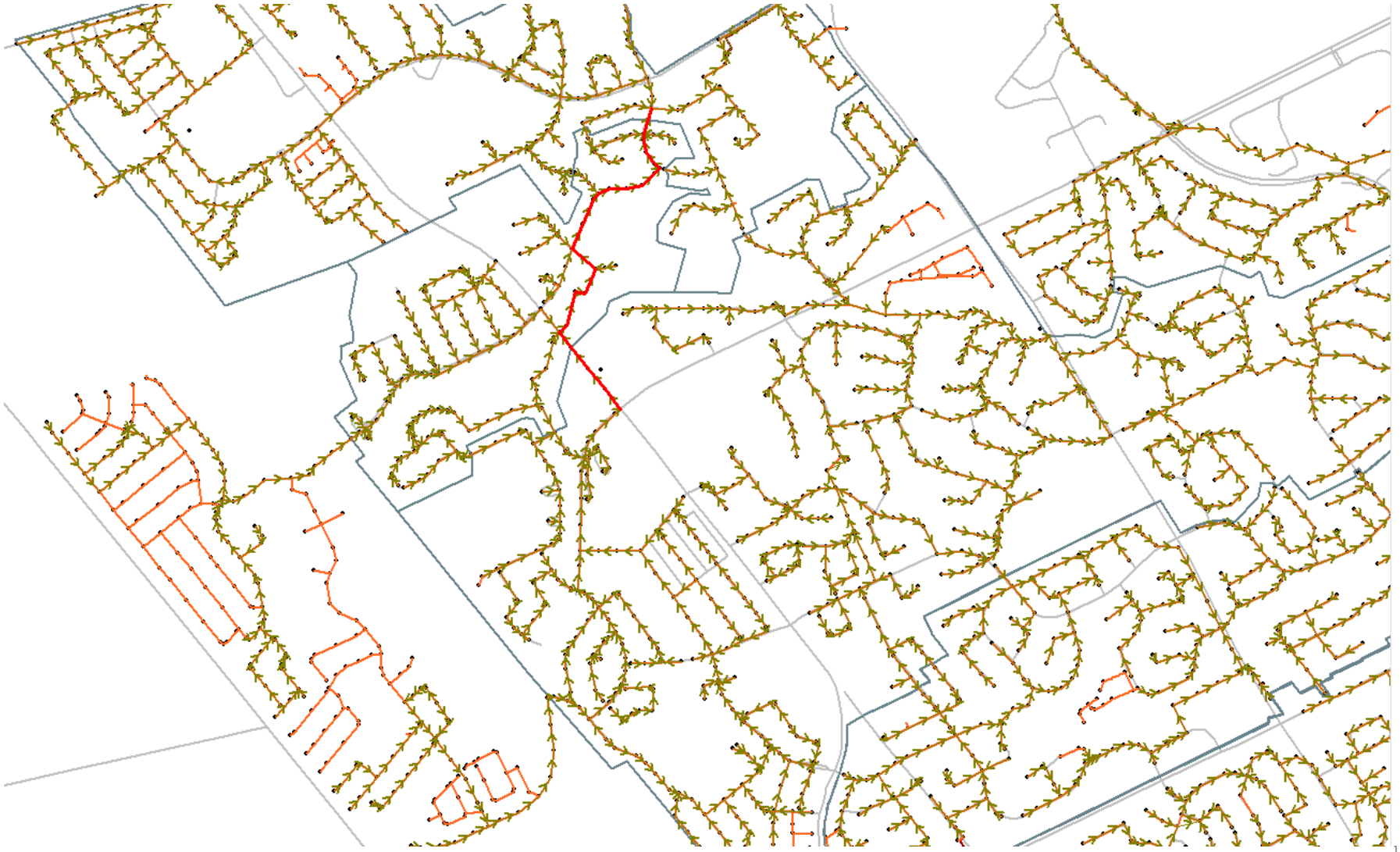

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Figure No. 1

Title **Cedar Trunk 1 – Profile 2 Overview**

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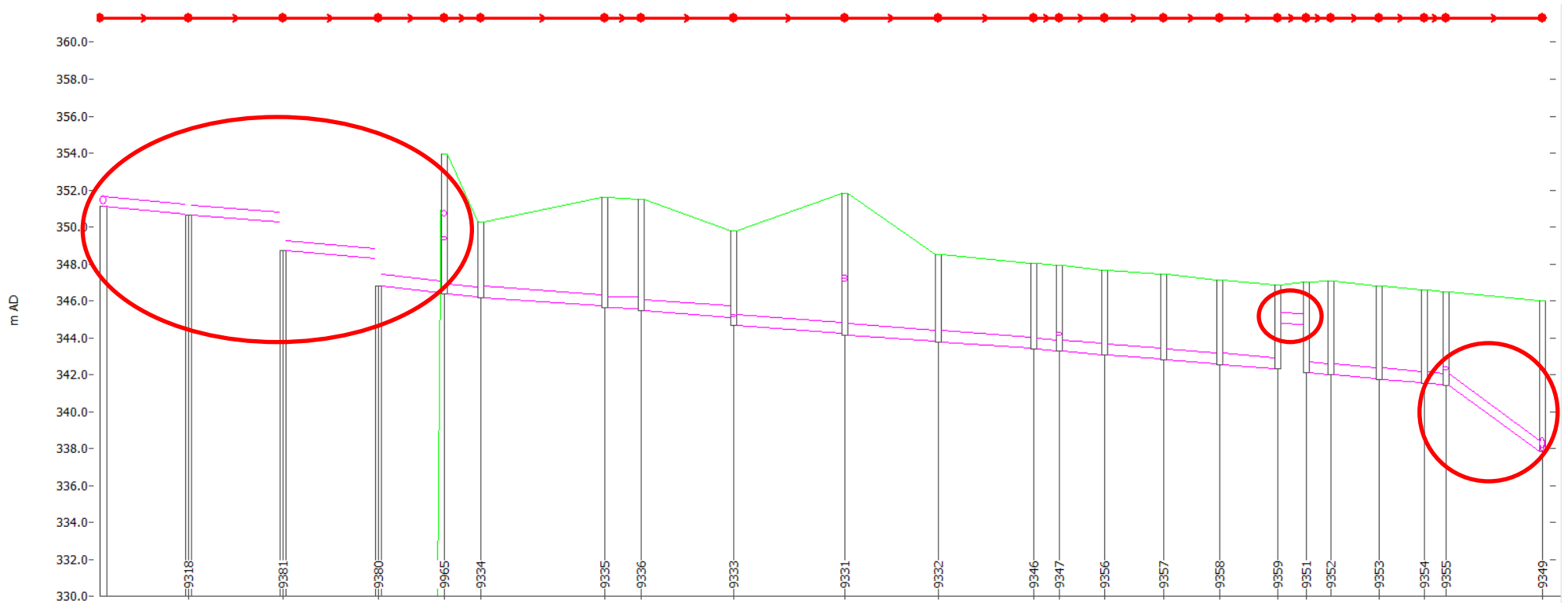
m AD
360.0
358.0
356.0
354.0
352.0
350.0
348.0
346.0
344.0
342.0
340.0
338.0
336.0
334.0
332.0
330.0
m
86
177
268
332
367
487
522
611
718
808
900
925
969
1026
1080
1136
1163
1233
1276
1391
9318
9381
9380
9965
9334
9335
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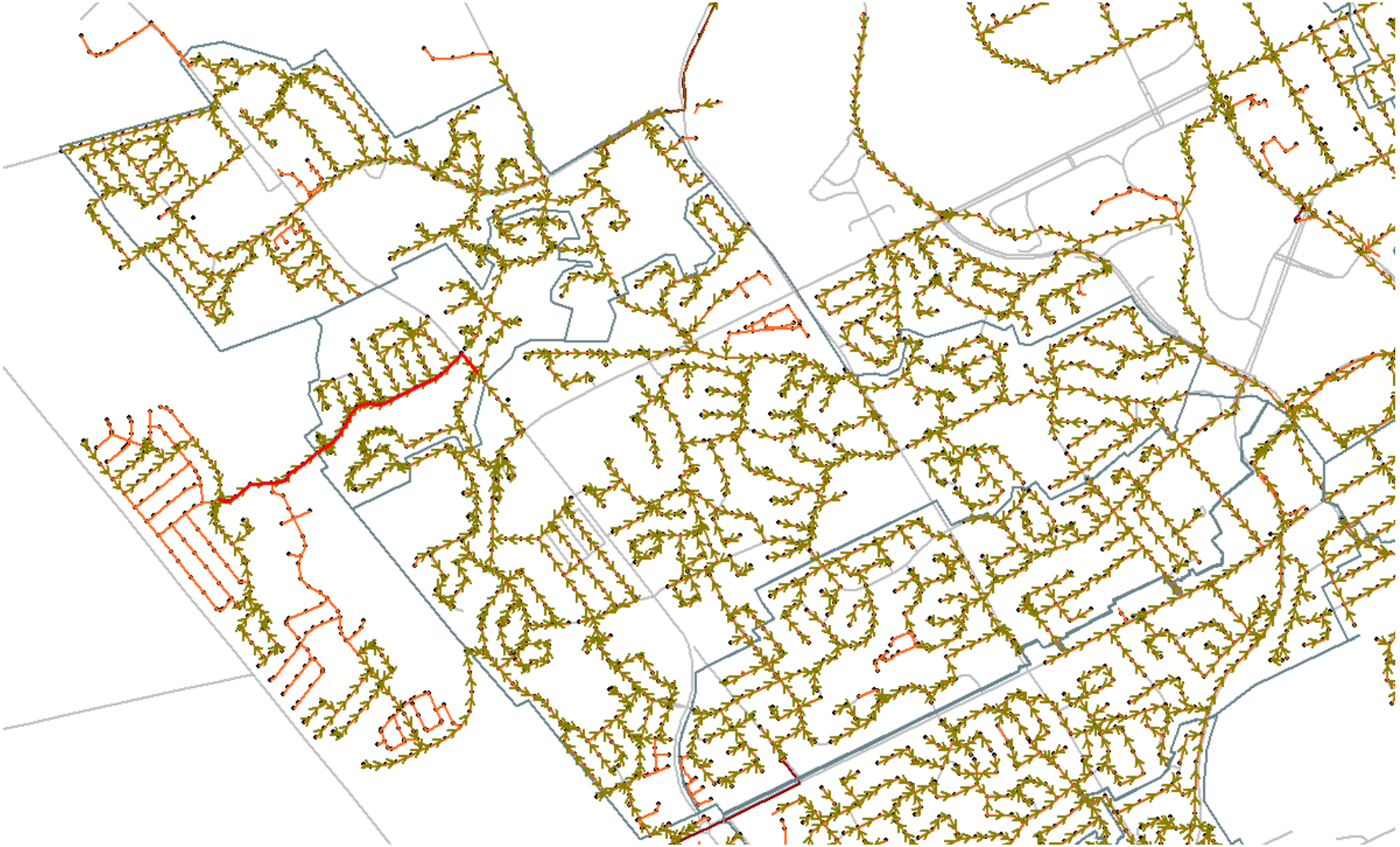
| | | |



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Legend

Figure No. 1

Title **Cedar Trunk 2 – Profile Overview**

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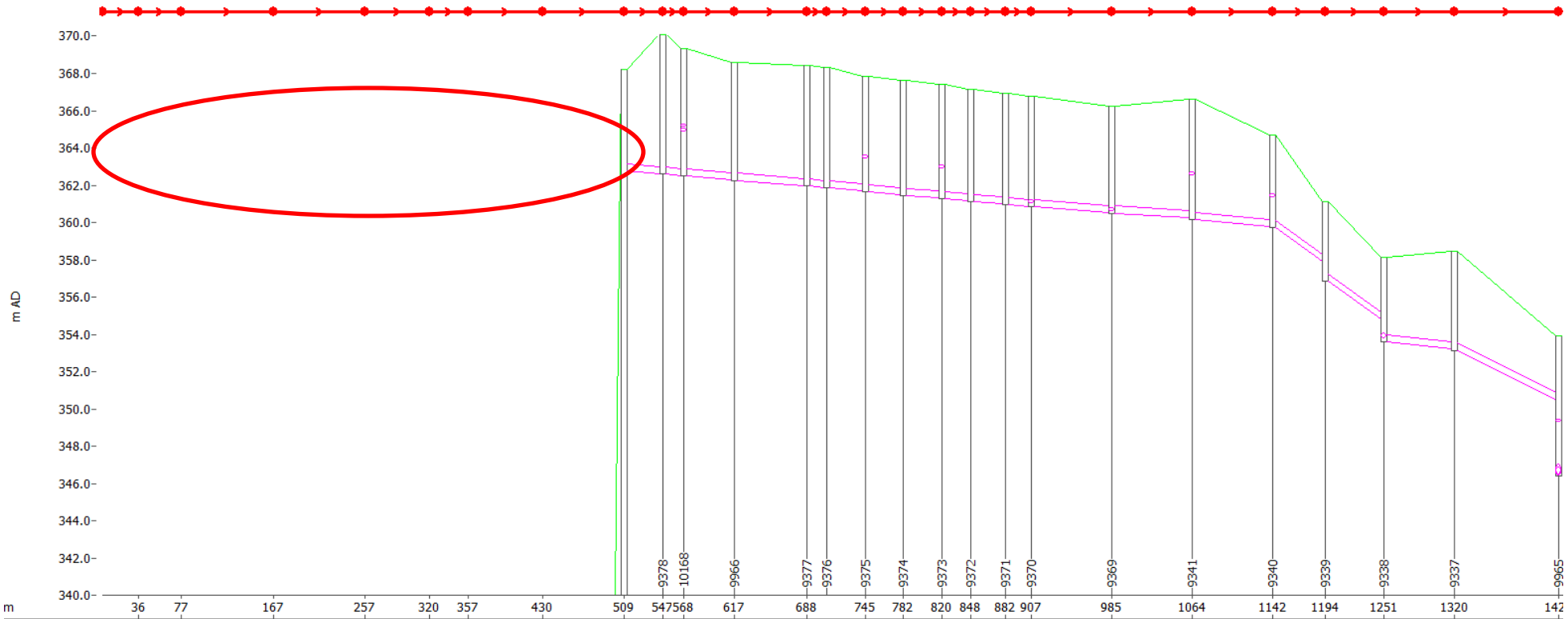

m		36	77	167	257	320	357	430	509	547	568	617	688	745	782	820	848	882	907	985	1064	1142	1194	1251	1320	142
Link	-	-	15923.1	15924.1	15902.1	-	15926.1	15927.1	9379.1	-	10168.1	9966.1	-	9376.1	-	9374.1	-	-	-	9370.1	9369.1	9341.1	9340.1	9339.1	9338.1	9337.1	
length (m)	35.8	41.1	90.0	90.0	63.1	37.0	73.5	79.1	37.8	-	48.9	71.4	-	37.6	37.3	37.9	28.1	33.4	25.2	78.5	78.9	77.8	51.9	57.0	69.2	101.1	
width (mm)	250	300	300	300	300	300	300	300	375	375	375	375	-	375	375	375	375	375	375	375	375	375	375	375	375	375	
us inv (m AD)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-	-	362.498	362.272	-	-	-	-	-	-	-	360.856	360.515	360.170	359.748	356.850	353.607	353.160	
ds inv (m AD)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-	-	362.302	361.986	-	-	-	-	-	-	-	360.551	360.260	359.778	357.928	354.855	353.262	350.525	
grad (m/m)	-	-	0.00000	0.00000	0.00000	-	0.00000	0.00000	-	-	0.00401	0.00401	-	-	-	-	-	-	-	0.00388	0.00323	0.00504	0.03505	0.03500	0.00498	0.02607	
pfc (m3/s)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.111	-	0.111	0.111	-	0.118	0.119	0.102	-	0.111	-	0.109	0.100	0.124	0.328	0.328	0.124	0.283	
User Text 3	Active	Active	Active	Active	Active	Active	Active	Active	Active	-	Active	Active	-	Active	Active	Active	-	Active	-	Active	Active	Active	Active	Active	Active	Active	
Node	-	15923	15924	15902	15925	15926	15927	9379	-	-	9966	9377	-	9375	9374	-	-	-		9370	9369	9341	9340	9339	9338	9337	9965
ground (m AD)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	368.200	-	-	368.600	-	-	-	-	-	-	-		366.785	366.217	366.609	364.715	361.120	358.163	358.470	-
User Text 2	-	Active	Active	Active	Active	Active	Active	Active	-	-	Active	Active	-	-	-	-	-	-		Active	Active	Active	Active	Active	Active	Active	Active

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Figure No. 1

Title **Cedar Trunk 2 - Profile**

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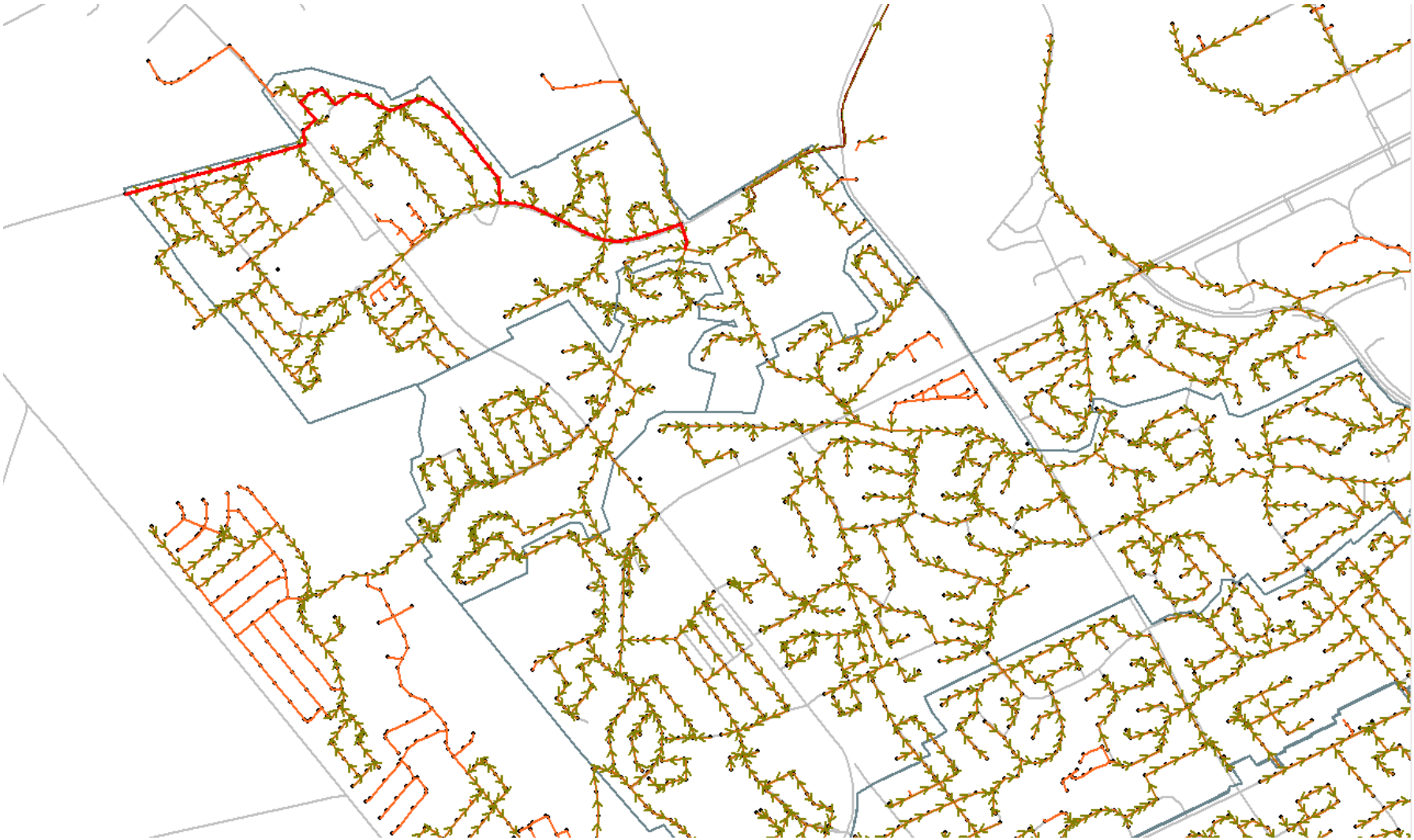

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Figure No. 1

Title **Cedar Trunk 3 – Profile Overview**

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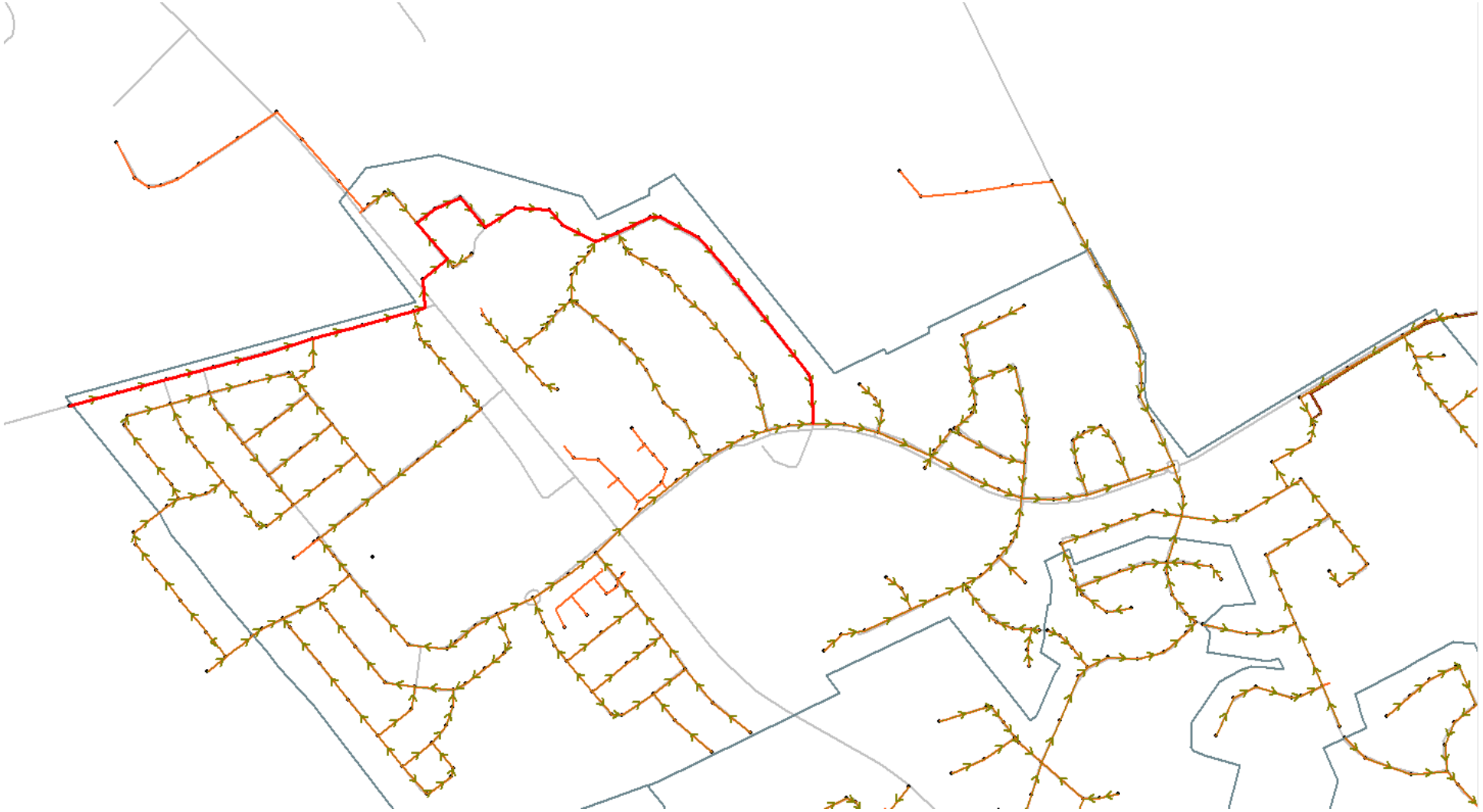

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Figure No. 1

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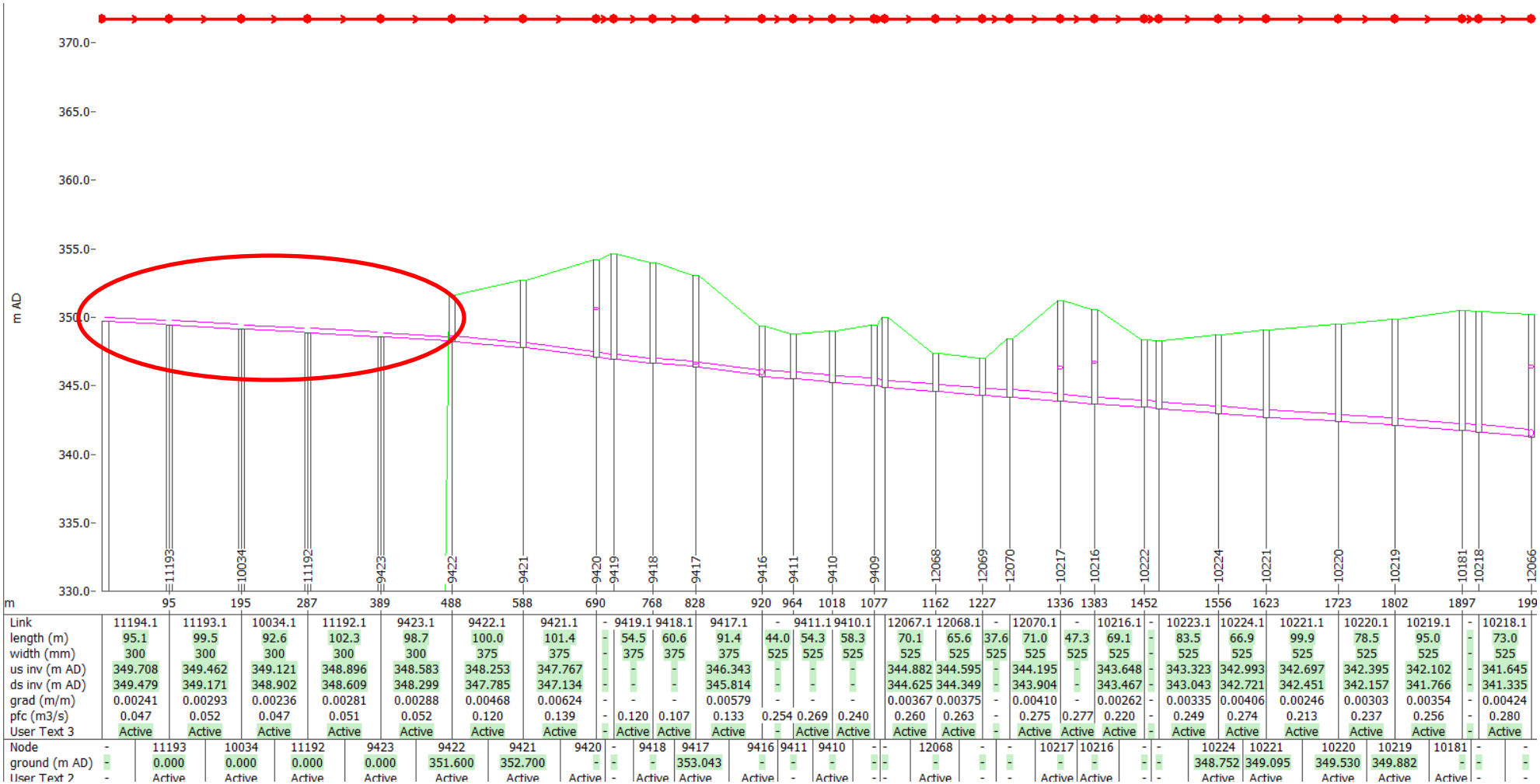

Link	11194.1	11193.1	10034.1	11192.1	9423.1	9422.1	9421.1	-	9419.1	9418.1	9417.1	-	9411.1	9410.1	12067.1	12068.1	-	12070.1	-	10216.1	-	10223.1	10224.1	10221.1	10220.1	10219.1	-	10218.1
length (m)	95.1	99.5	92.6	102.3	98.7	100.0	101.4	-	54.5	60.6	91.4	44.0	54.3	58.3	70.1	65.6	37.6	71.0	47.3	69.1	-	83.5	66.9	99.9	78.5	95.0	-	73.0
width (mm)	300	300	300	300	300	375	375	-	375	375	375	525	525	525	525	525	525	525	525	525	-	525	525	525	525	525	-	525
us inv (m AD)	349.708	349.462	349.121	348.896	348.583	348.253	347.767	-	-	-	346.343	-	-	-	344.882	344.595	-	344.195	-	343.648	-	343.323	342.993	342.697	342.395	342.102	-	341.645
ds inv (m AD)	349.479	349.171	348.902	348.609	348.299	347.785	347.134	-	-	-	345.814	-	-	-	344.625	344.349	-	343.904	-	343.467	-	343.043	342.721	342.451	342.157	341.766	-	341.335
grad (m/m)	0.00241	0.00293	0.00236	0.00281	0.00288	0.00468	0.00624	-	-	-	0.00579	-	-	-	0.00367	0.00375	-	0.00410	-	0.00262	-	0.00335	0.00406	0.00246	0.00303	0.00354	-	0.00424
pfc (m3/s)	0.047	0.052	0.047	0.051	0.052	0.120	0.139	-	0.120	0.107	0.133	0.254	0.269	0.240	0.260	0.263	-	0.275	0.277	0.220	-	0.249	0.274	0.213	0.237	0.256	-	0.280
User Text 3	Active	Active	Active	Active	Active	Active	Active	-	Active	Active	Active	-	Active	Active	Active	Active	-	Active	Active	Active	-	Active	Active	Active	Active	Active	-	Active
Node	-	11193	10034	11192	9423	9422	9421	9420	-	9418	9417	9416	9411	9410	-	-	12068	-	-	10217	10216	-	-	10224	10221	10220	10219	10181	-	-
ground (m AD)	-	0.000	0.000	0.000	0.000	351.600	352.700	-	-	-	353.043	-	-	-	-	-	-	-	-	-	-	-	348.752	349.095	349.530	349.882	-	-	-
User Text 2	-	Active	Active	Active	Active	Active	Active	Active	-	Active	Active	Active	-	Active	-	-	Active	-	-	Active	Active	-	-	Active	Active	Active	Active	Active	-	-

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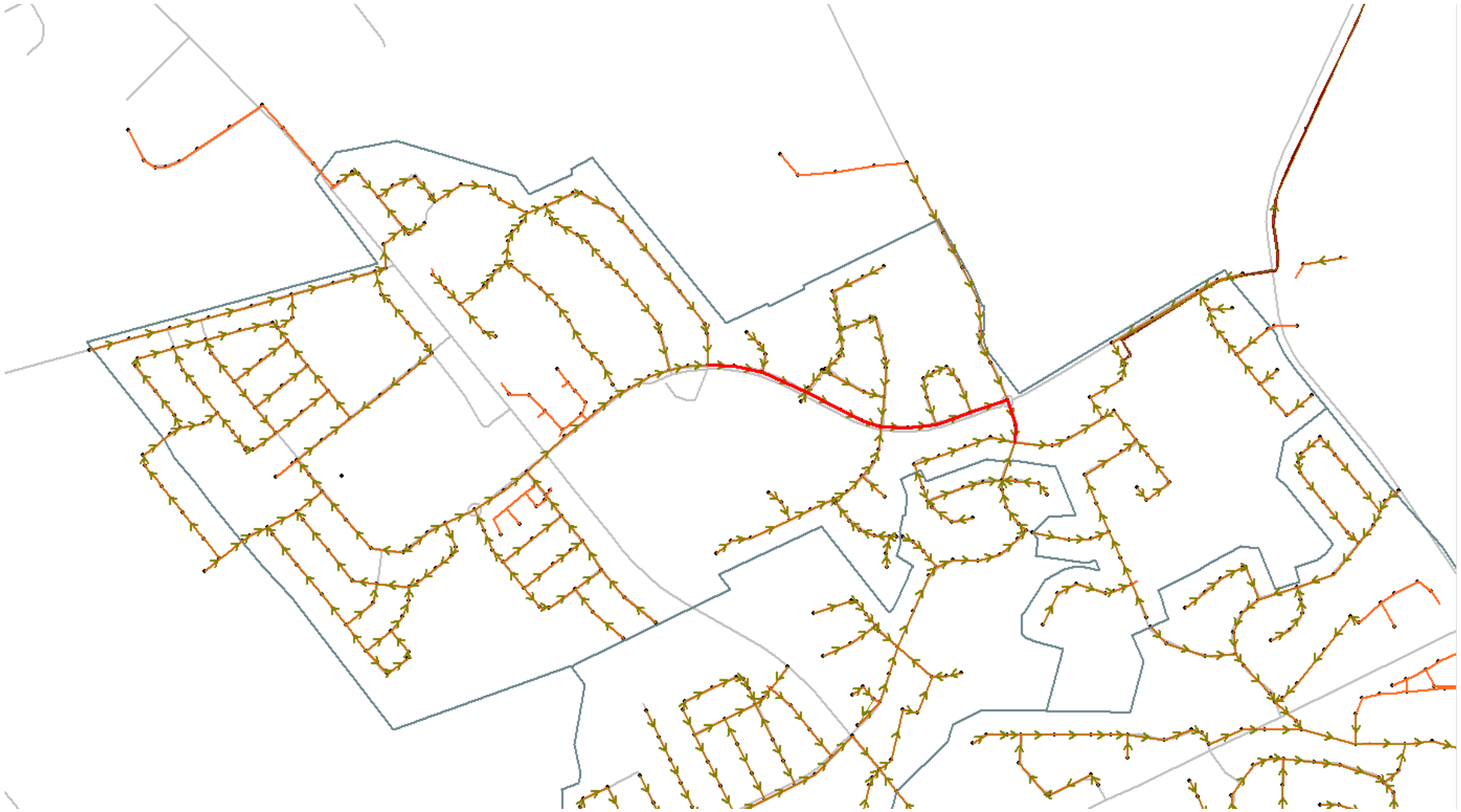
Legend

Figure No. 1

Title **Cedar Trunk 3 Profile 1**

Client/Project City of Waterloo

Waterloo Sanitary Servicing Master Plan



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Legend

Figure No. 1

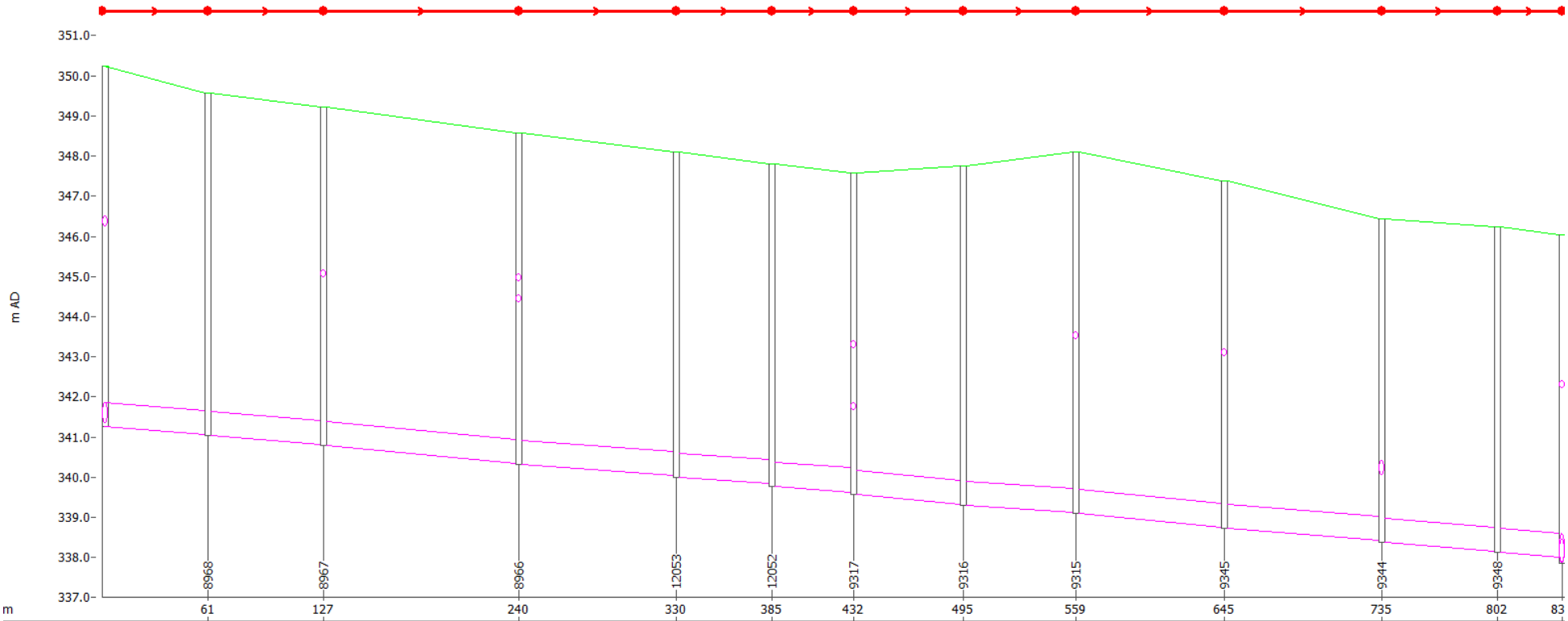
Title **Cedar Trunk 3 – Profile 2 Overview**

Stantec Consulting Ltd.
49 Frederick Street
Kitchener, Ontario, Canada
N2H 6M7
Tel: (519) 579-4410
Fax: (519) 579-6733
www.stantec.comt

Client/Project City of Waterloo

Waterloo Sanitary Servicing Master Plan

Drawing is not to be used for construction



Link	12066.1	8968.1	8967.1	8966.1	12053.1	12052.1	9317.1	9316.1	9315.1	9345.1	9344.1	9348.1	
length (m)	60.9	66.5	112.3	90.1	55.4	46.6	63.3	64.4	85.5	90.5	66.3	37.4	
width (mm)	600	600	600	600	600	600	600	600	600	600	600	600	
us inv (m AD)	341.258	341.033	340.794	340.313	339.996	339.779	339.570	339.289	339.092	338.717	338.377	338.128	
ds inv (m AD)	341.063	340.824	340.333	340.046	339.839	339.633	339.328	339.124	338.755	338.437	338.158	337.997	
grad (m/m)	0.00320	0.00314	0.00411	0.00296	0.00284	0.00313	0.00382	0.00256	0.00394	0.00309	0.00330	0.00351	
pfc (m3/s)	0.347	0.344	0.393	0.334	0.327	0.344	0.380	0.311	0.386	0.342	0.353	0.364	
User Text 3	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	
Node	12066	8968	8967	8966	12053	12052	9317	9316	9315	9345	9344	9348	-
ground (m AD)	350.240	349.561	349.228	348.580	348.110	347.800	347.580	347.755	348.095	347.389	346.434	346.230	-
User Text 2	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	-

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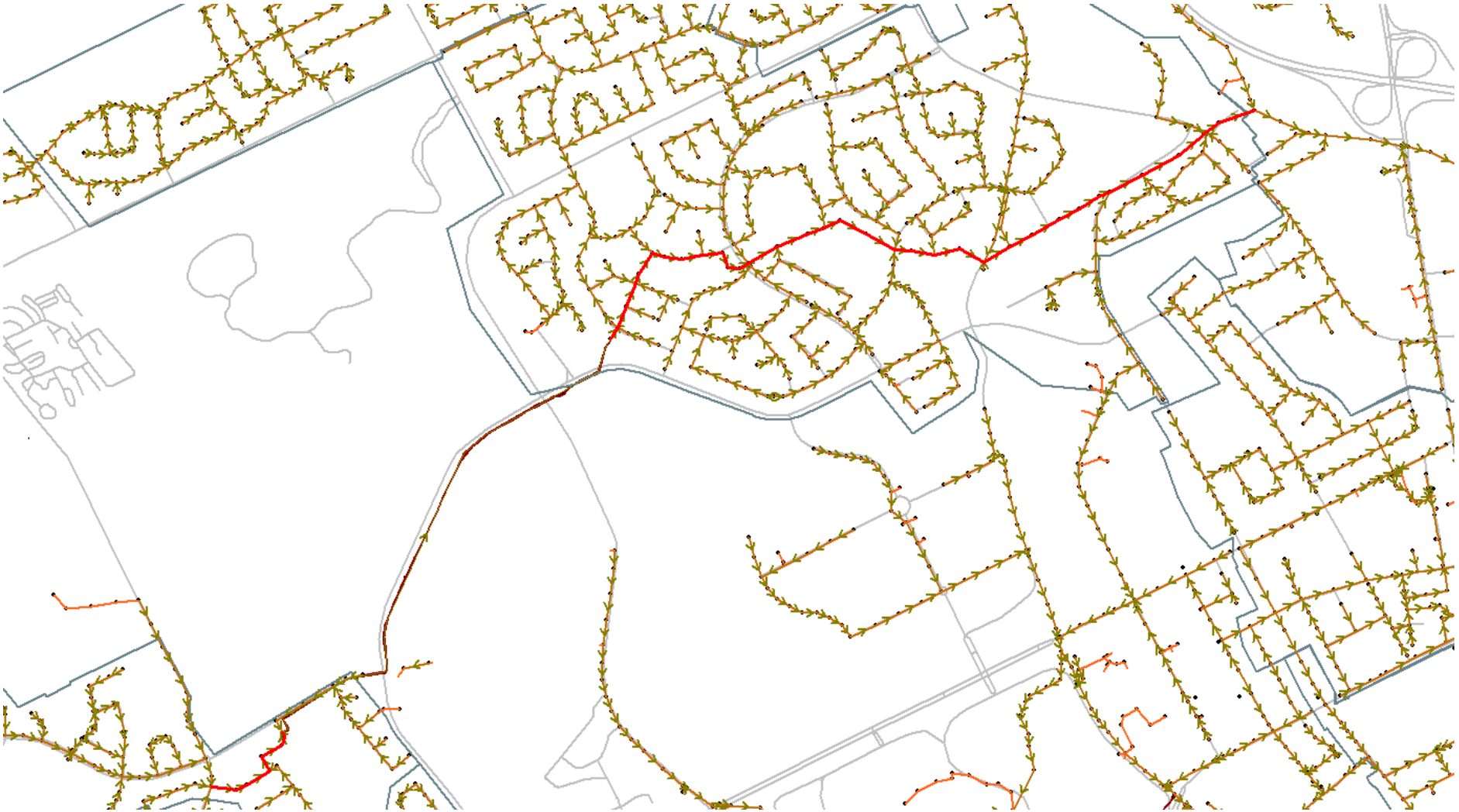

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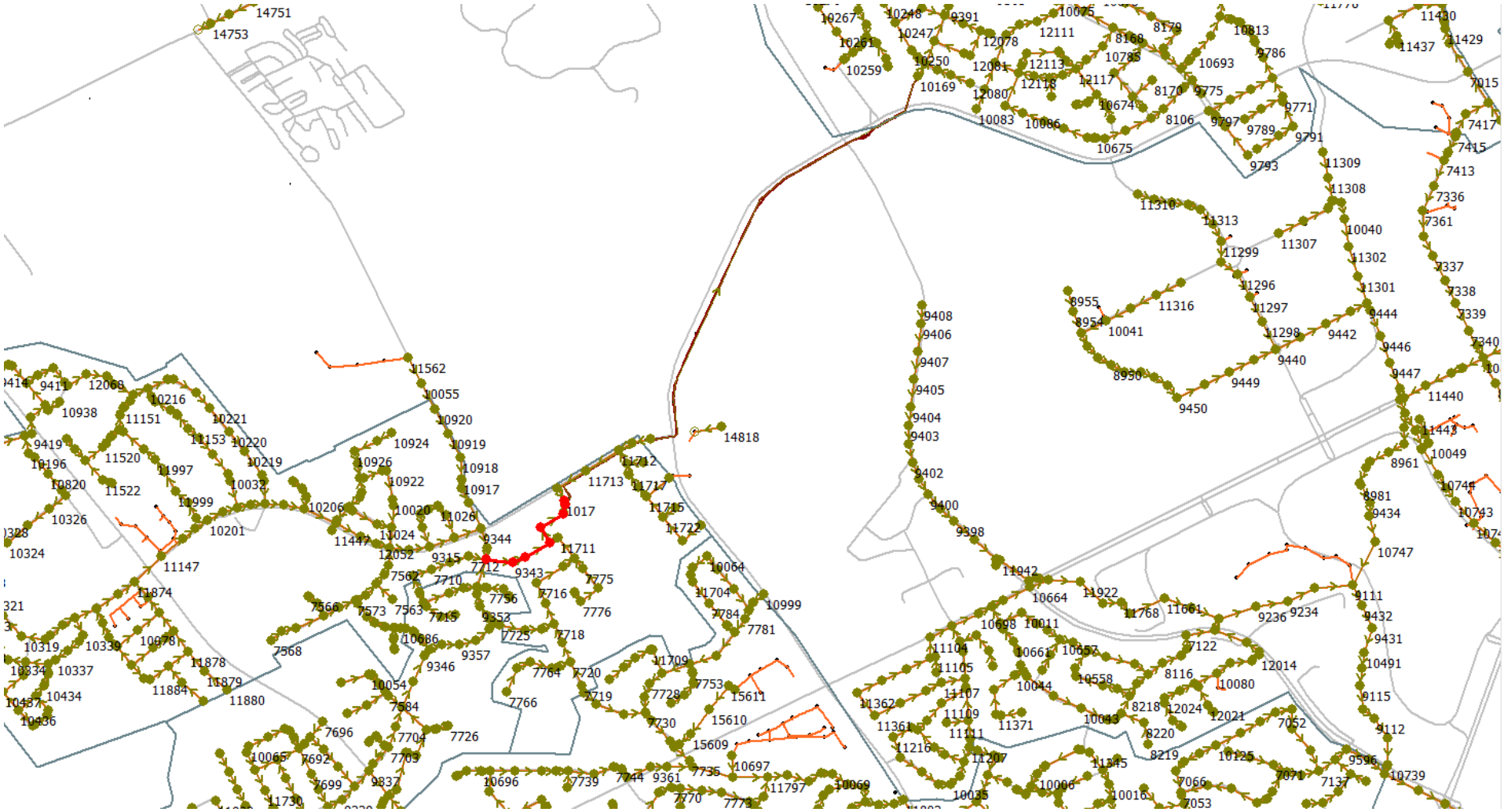

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Figure No. 1

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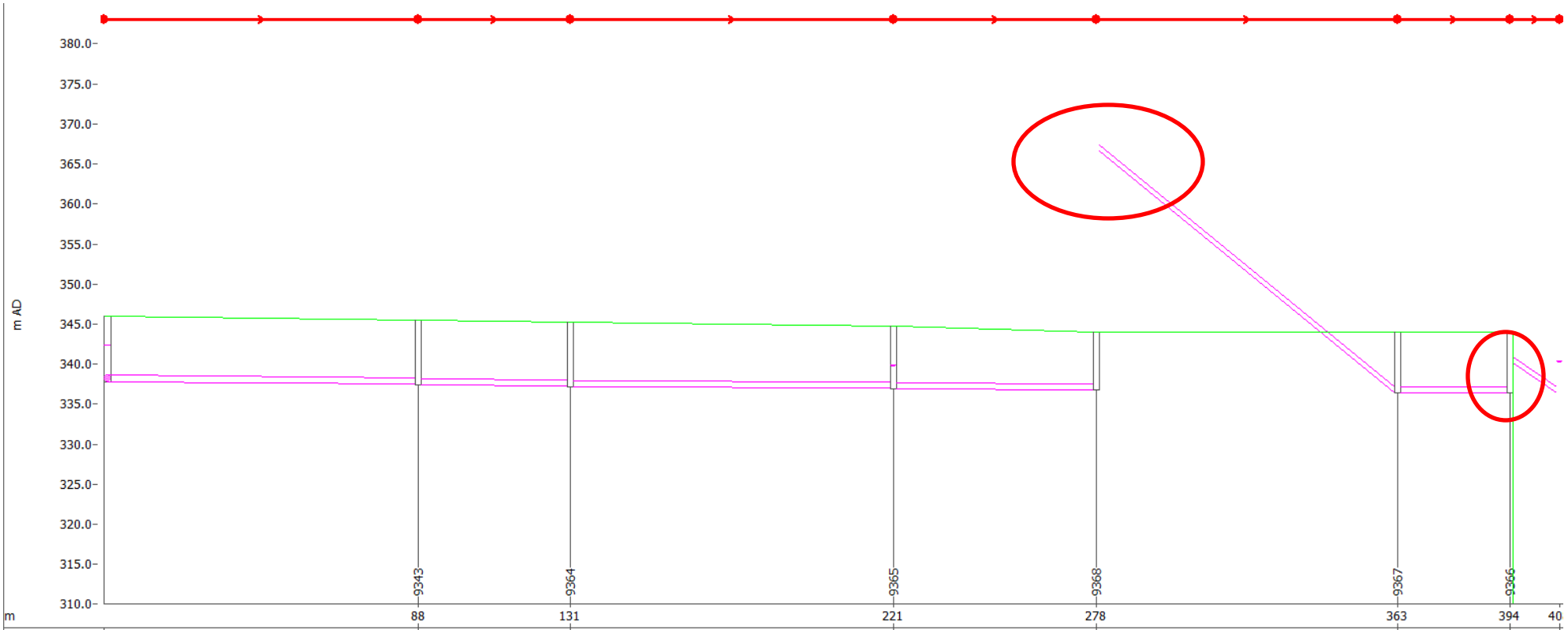

Link	9349.1	9343.1	9364.1	9365.1	9368.1	9367.1	9366.1
length (m)	88.3	42.7	90.5	57.0	84.3	31.5	14.1
width (mm)	750	750	750	750	750	750	750
us inv (m AD)	337.847	337.459	337.199	336.955	366.670	336.410	340.200
ds inv (m AD)	337.539	337.300	337.015	336.768	336.410	336.390	336.390
grad (m/m)	0.00349	0.00373	0.00203	0.00328	0.35886	0.00063	0.26948
pfc (m3/s)	0.658	0.680	0.502	0.638	6.670	0.280	5.780
User Text 3	Active	Active	Active	Active	Active	Active	Active

Node	9349	9343	9364	9365	9368	9367	9366	-
ground (m AD)	346.033	345.478	345.250	344.764	344.000	344.000	344.000	
User Text 2	Active	Active	Active	Active	Active	Active	Active	

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Figure No. 1

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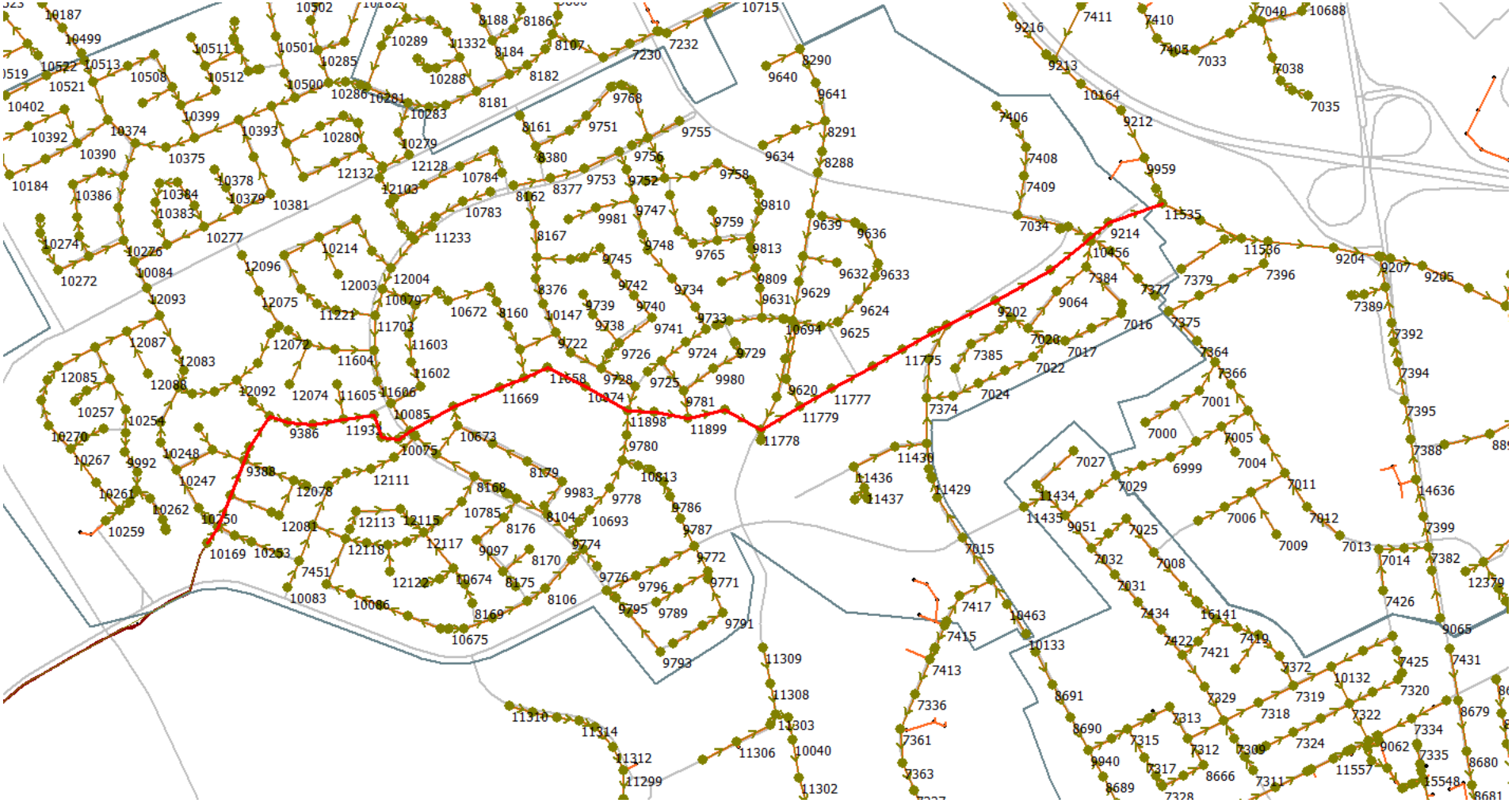

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Figure No. 1

Title **Cedar Trunk – Profile 2 Overview**

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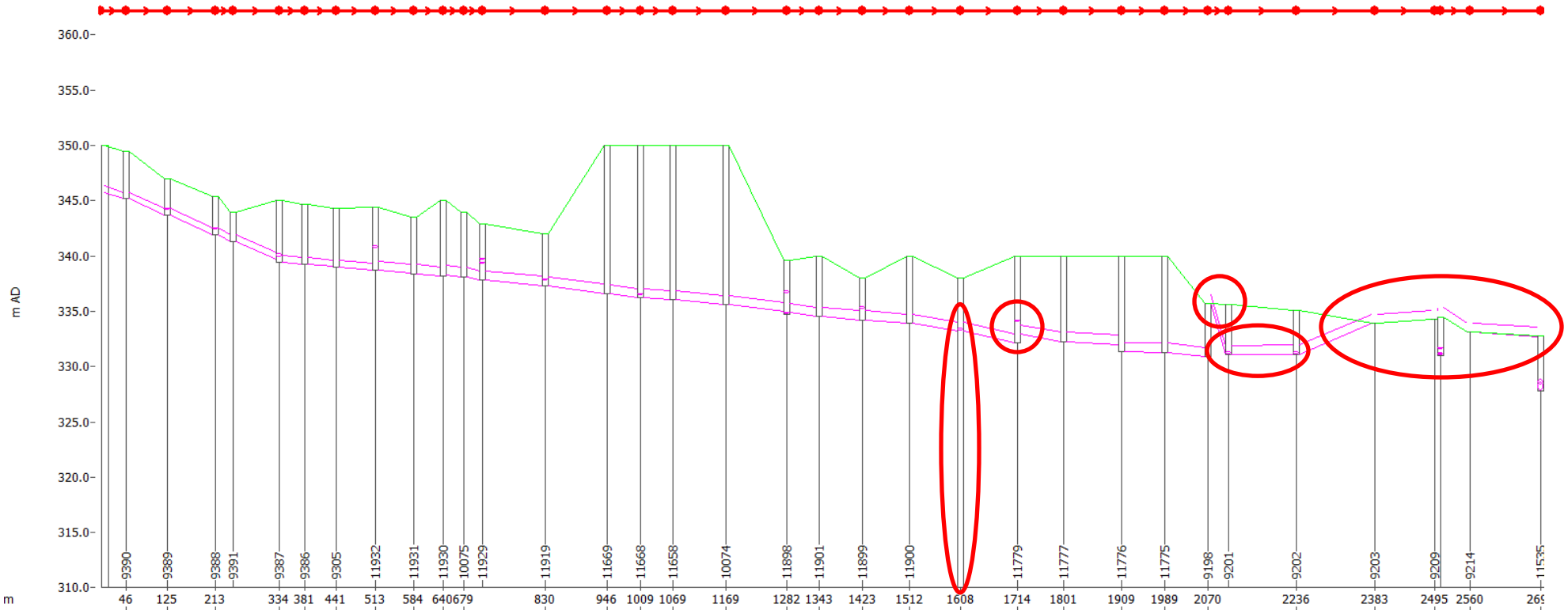

m	46	125	213	334	381	441	513	584	640	679	830	946	1009	1069	1169	1282	1343	1423	1512	1608	1714	1801	1909	1989	2070	2236	2383	2495	2560	269
Link	-	9390.1	9389.1	-	9391.1	-	-	9305.1	-	-	-	-	11929.1	11919.1	-	-	11658.1	10074.1	-	-	11899.1	11900.1	11778.1	11779.1	11777.1	-	-	-	9201.1	9202.1	9203.1	-	9214.1	
length (m)	46.1	78.6	88.7	-	85.9	47.0	59.9	72.0	71.6	55.7	-	-	117.2	116.1	62.1	60.3	100.1	112.7	61.5	79.6	89.0	96.0	106.7	86.1	108.3	79.8	81.4	-	127.0	147.1	111.9	54.4	132.6	
width (mm)	600	600	600	-	600	600	600	600	825	825	825	-	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825	
us inv (m AD)	-	-	343.707	-	341.300	-	-	-	-	-	-	-	337.810	337.296	-	-	336.071	335.613	-	-	334.221	333.896	333.240	332.914	332.267	-	-	-	331.110	331.120	333.890	-	333.140	
ds inv (m AD)	-	-	341.952	-	339.694	-	-	-	-	-	-	-	337.336	336.634	-	-	335.633	334.972	-	-	333.926	333.240	332.144	332.287	332.009	-	-	-	331.120	333.890	334.290	-	332.710	
grad (m/m)	-	-	0.01978	-	0.01870	-	-	-	-	-	-	-	0.00404	0.00570	-	-	0.00437	0.00569	-	-	0.00331	0.00683	0.01027	0.00728	0.00238	-	-	-	-0.00008	-0.01883	-0.00357	-	0.00324	
pfc (m3/s)	-	0.832	0.864	-	0.840	-	0.367	0.371	0.848	-	-	-	0.913	1.084	1.136	0.651	0.950	1.083	1.096	0.856	0.827	1.187	1.455	1.225	0.701	0.134	1.010	-	-0.127	-1.970	-0.858	-	0.817	
User Text 3	-	Active	Active	-	Active	-	-	Active	Active	-	-	-	Active	Active	Active	-	Active	Active	-	Active	Active	Active	Active	Active	Active	Active	Active	-	Active	Active	Active	-	Active	
Node	-	9389	-	-	9387	-	9305	-	-	-	-	-	11919	11669	-	11658	10074	11898	-	11899	11900	11778	11779	11777	11776	11775	-	9201	9202	9203	-	9214	-	
ground (m AD)	-	-	-	-	-	-	-	-	-	-	-	-	342.000	-	-	-	350.000	-	-	-	-	338.000	340.000	340.000	-	-	-	-	335.057	333.899	-	-	-	
User Text 2	-	Active	-	-	-	-	-	-	-	-	-	Active	Active	Active	-	Active	Active	Active	-	Active	Active	Active	Active	Active	Active	Active	-	Active	Active	Active	-	Active	-	

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Legend

Figure No. 1

Title **Cedar Trunk – Profile 2**

Stantec Consulting Ltd.
49 Frederick Street
Kitchener, Ontario, Canada
N2H 6M7
Tel: (519) 579-4410
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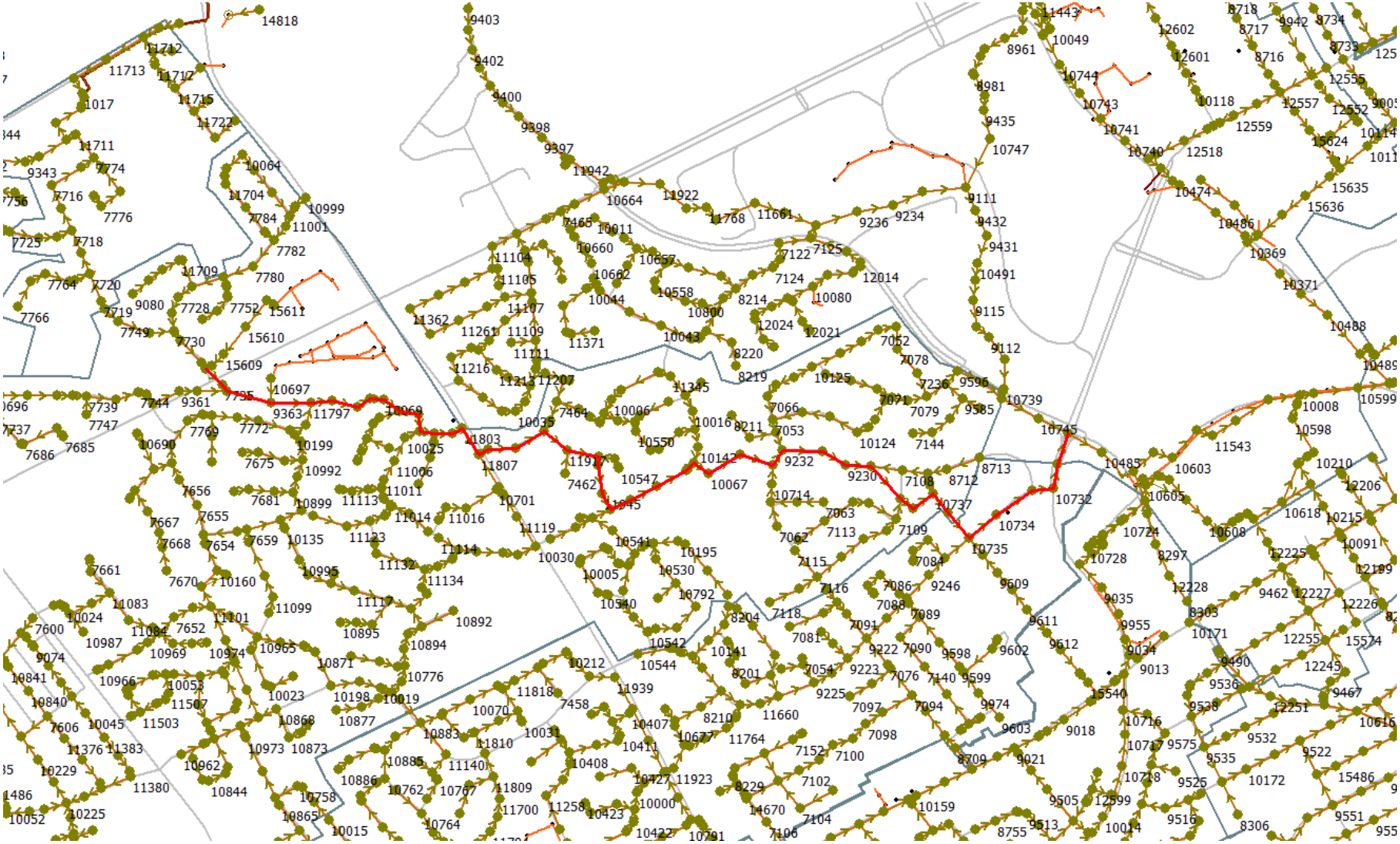
www.stantec.comt

Client/Project City of Waterloo

Waterloo Sanitary Servicing Master Plan

Drawing is not to be used for construction



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Legend

Figure No. 1

Title **Clair Trunk Geoplan Overview**

Stantec Consulting Ltd.
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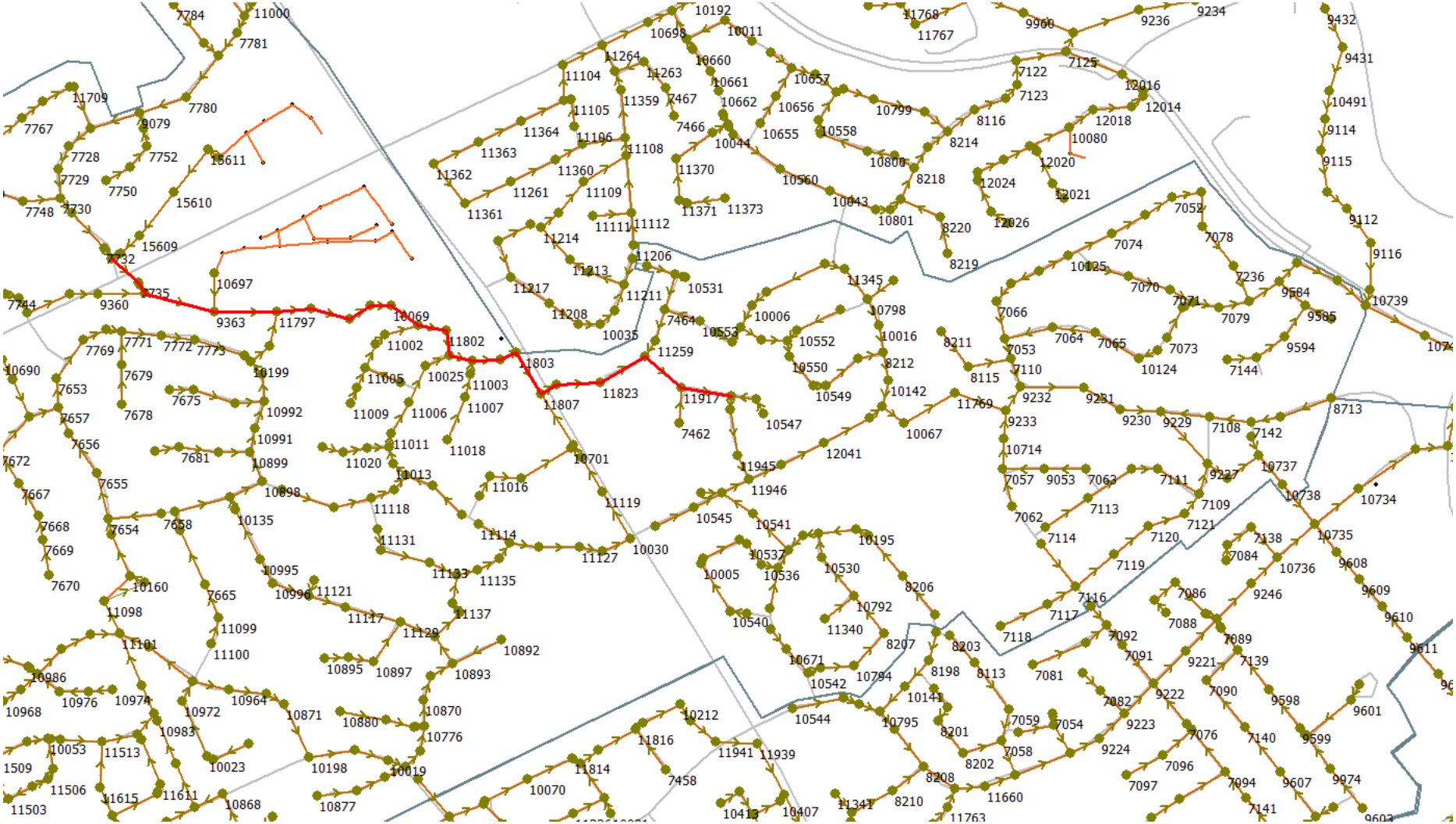

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Legend

Figure No. 1

Title **Clair Trunk Profile 1 Overview**

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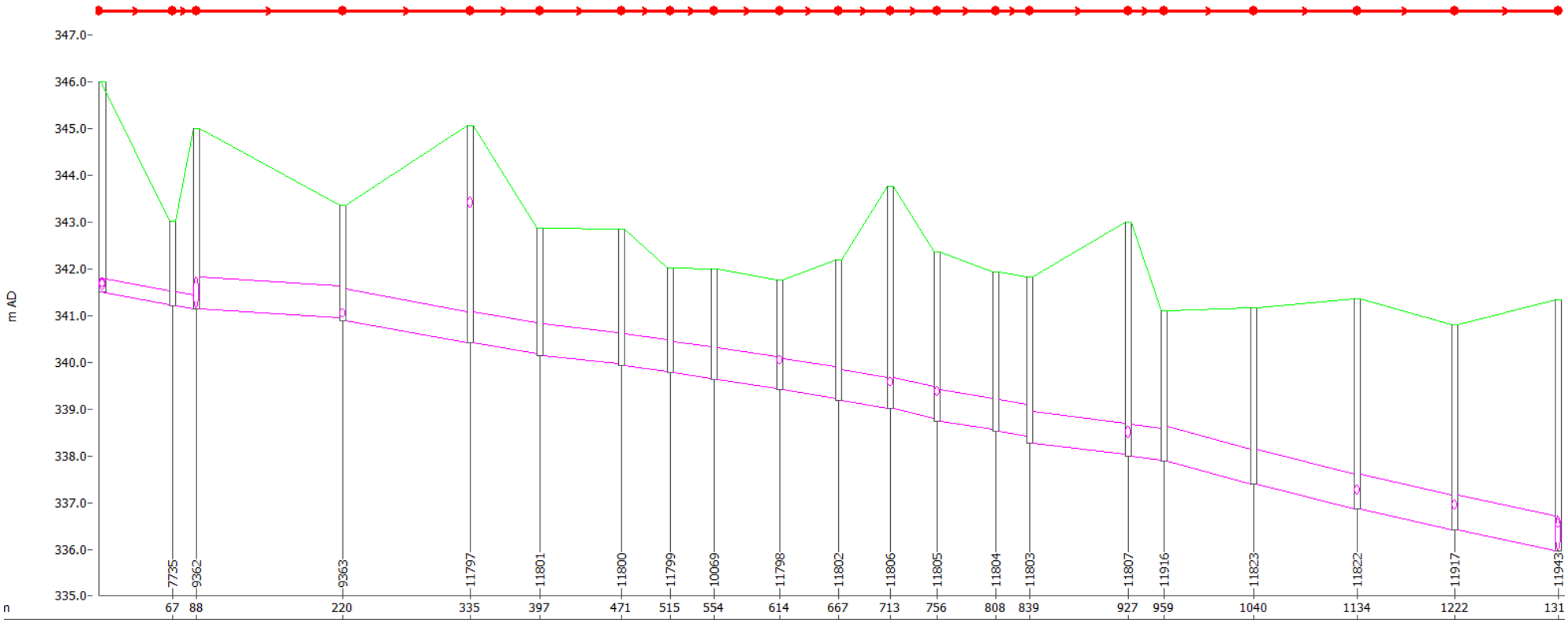
Waterloo Sanitary Servicing Master Plan



n		67	88	220	335	397	471	515	554	614	667	713	756	808	839	927	959	1040	1134	1222	131
Link	7733.1	-	9362.1	9363.1	11797.1	11801.1	11800.1	-	10069.1	11798.1	11802.1	11806.1	11805.1	-	11803.1	-	11916.1	11823.1	11822.1	11917.1	
length (m)	67.0	-	131.8	114.8	62.4	73.4	44.5	38.8	59.5	53.3	46.2	42.6	52.4	30.8	88.7	32.0	81.1	93.4	87.7	92.7	
width (mm)	300	300	675	675	675	675	675	675	675	675	675	675	675	675	675	675	750	750	750	750	
us inv (m AD)	341.520	-	341.151	340.900	340.416	340.156	339.937	-	339.633	339.415	339.178	339.012	338.745	-	338.280	-	337.880	337.390	336.870	336.420	
ds inv (m AD)	341.240	-	340.955	340.416	340.186	339.967	339.807	-	339.445	339.238	339.012	338.805	338.565	-	338.030	-	337.390	336.870	336.420	335.970	
grad (m/m)	0.00418	-	0.00149	0.00422	0.00369	0.00258	0.00292	-	0.00316	0.00332	0.00360	0.00486	0.00344	-	0.00282	-	0.00605	0.00557	0.00513	0.00486	
pfc (m3/s)	0.063	-	0.324	0.546	0.510	0.427	0.455	0.455	0.473	0.484	0.504	0.586	0.493	0.514	0.446	0.421	0.866	0.831	0.797	0.776	
User Text 3	Active	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	
Node	7733	7735	9362	9363	11797	11801	11800	11799	10069	11798	11802	11806	11805	11804	11803	11807	11916	11823	11822	11917	11943
ground (m AD)	-	-	345.000	343.360	345.080	342.875	342.860	-	341.995	341.760	342.200	-	342.355	-	341.830	343.000	341.113	341.170	341.354	340.818	-
User Text 2	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active

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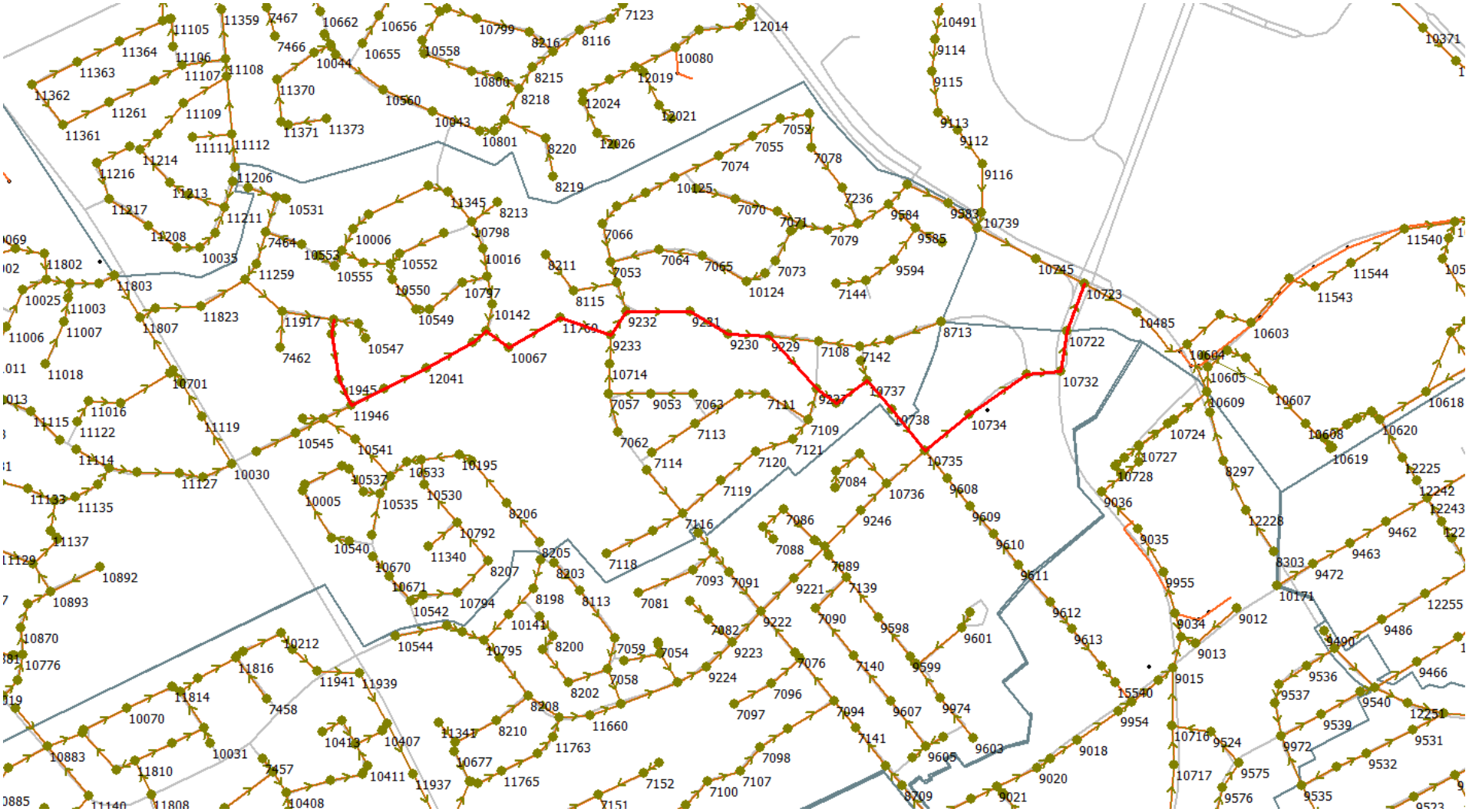

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Figure No. 1

Title **Clair Trunk Profile 2 Overview**

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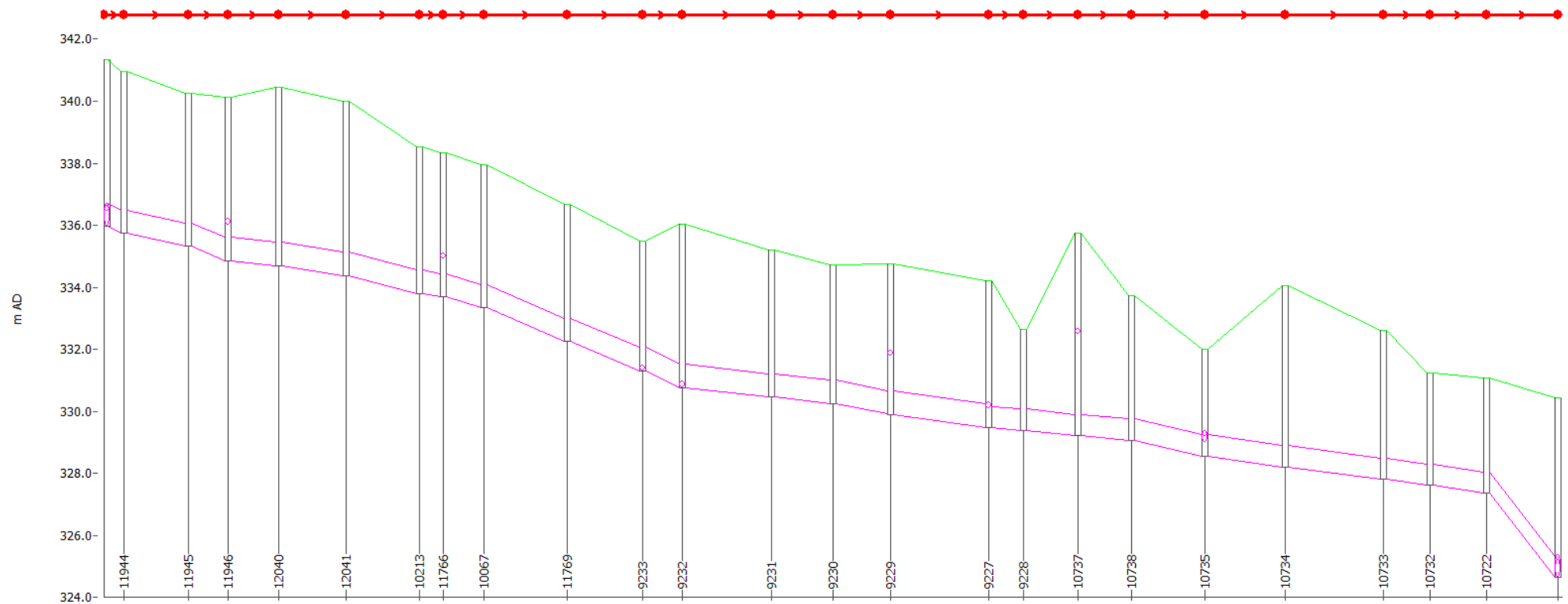

m

	26	109	160	225	311	406	437	488	595	693	744	858	937	1011	1138	1183	1253	1321	1416	1519	1645	1705	1777	1865			
Link	-	11944.1	-	11946.1	12040.1	12041.1	-	-	10067.1	11769.1	9233.1	9232.1	9231.1	9230.1	9229.1	-	9228.1	10737.1	10738.1	10735.1	10734.1	10733.1	10732.1	10722.1			
length (m)	-	83.3	50.2	65.7	85.7	95.1	-	51.3	107.2	97.3	50.9	114.6	78.9	73.7	127.2	44.6	70.0	68.5	94.3	103.4	125.6	60.4	72.1	92.3			
width (mm)	-	750	750	750	750	750	750	750	750	750	750	750	750	750	750	675	675	675	675	675	675	675	675	675			
us inv (m AD)	-	335.750	-	334.860	334.700	334.380	-	-	333.340	332.260	-	330.770	330.460	330.260	329.909	-	329.400	329.230	329.080	328.570	328.220	327.810	327.620	327.380			
ds inv (m AD)	-	335.330	-	334.700	334.380	333.810	-	-	332.260	331.310	-	330.460	330.260	329.930	329.490	-	329.230	329.080	328.570	328.220	327.810	327.620	327.380	324.640			
grad (m/m)	-	0.00504	-	0.00244	0.00373	0.00599	-	-	0.01008	0.00976	-	0.00270	0.00253	0.00448	0.00329	-	0.00243	0.00219	0.00541	0.00338	0.00326	0.00315	0.00333	0.02970			
pfc (m3/s)	-	0.790	1.077	0.550	0.680	0.862	-	0.920	1.118	1.100	1.146	0.579	0.560	0.745	0.639	0.378	0.414	0.393	0.618	0.489	0.480	0.472	0.485	1.449			
User Text 3	-	Active	Active	Active	Active	Active	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active			
Node	11944	11945	11946	12040	12041	10213	-	10067	11769	9233	9232	9231	9230	9229	9227	9228	10737	10738	10735	10734	10733	10732	10722	-			
ground (m AD)	-	-	-	340.437	339.996	-	-	337.953	336.685	335.489	336.052	335.191	334.741	334.749	334.217	-	335.760	333.750	332.019	334.056	332.604	-	331.077	-			
User Text 2	Active	Active	Active	Active	Active	Active	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	-			

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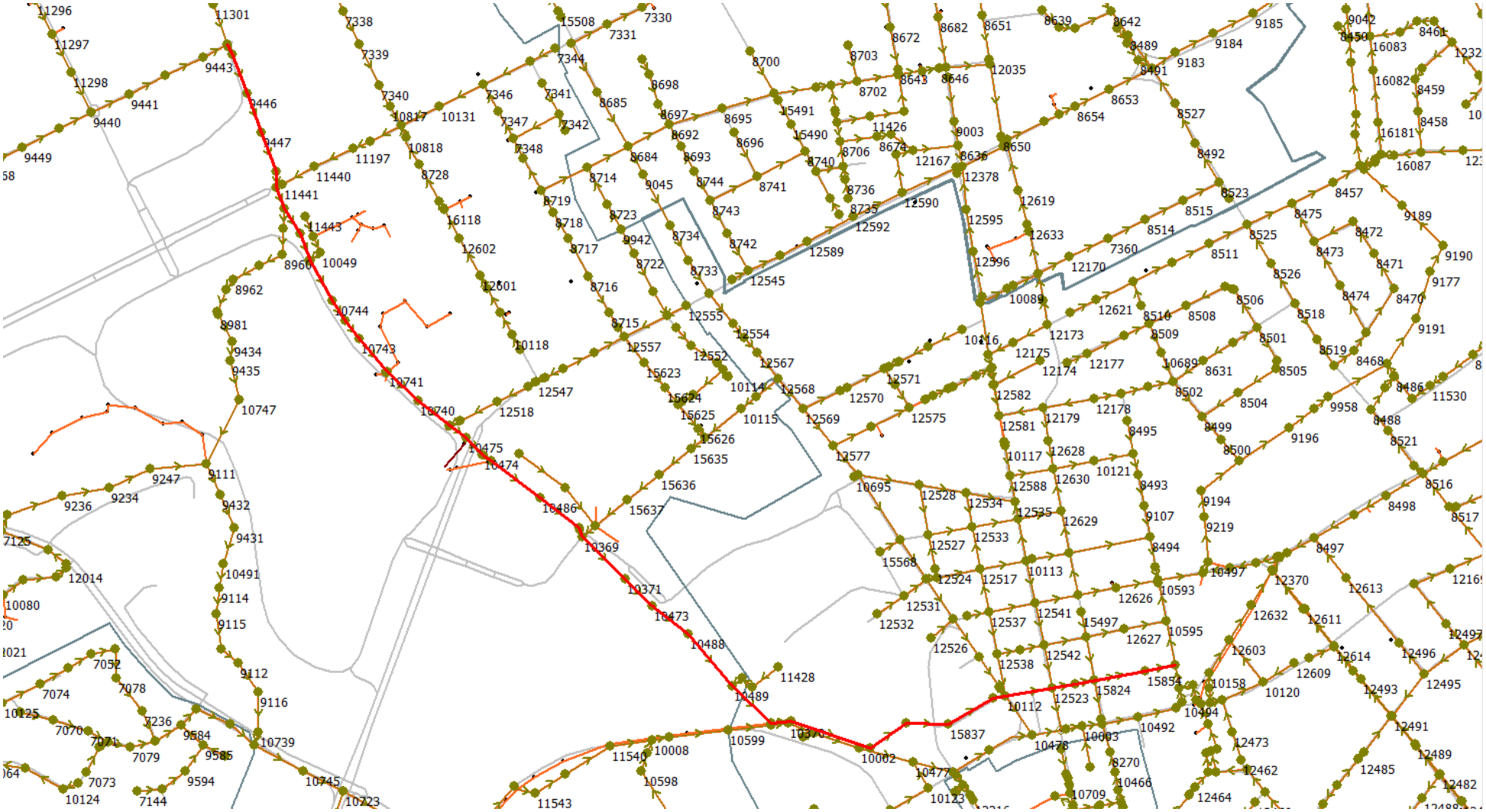

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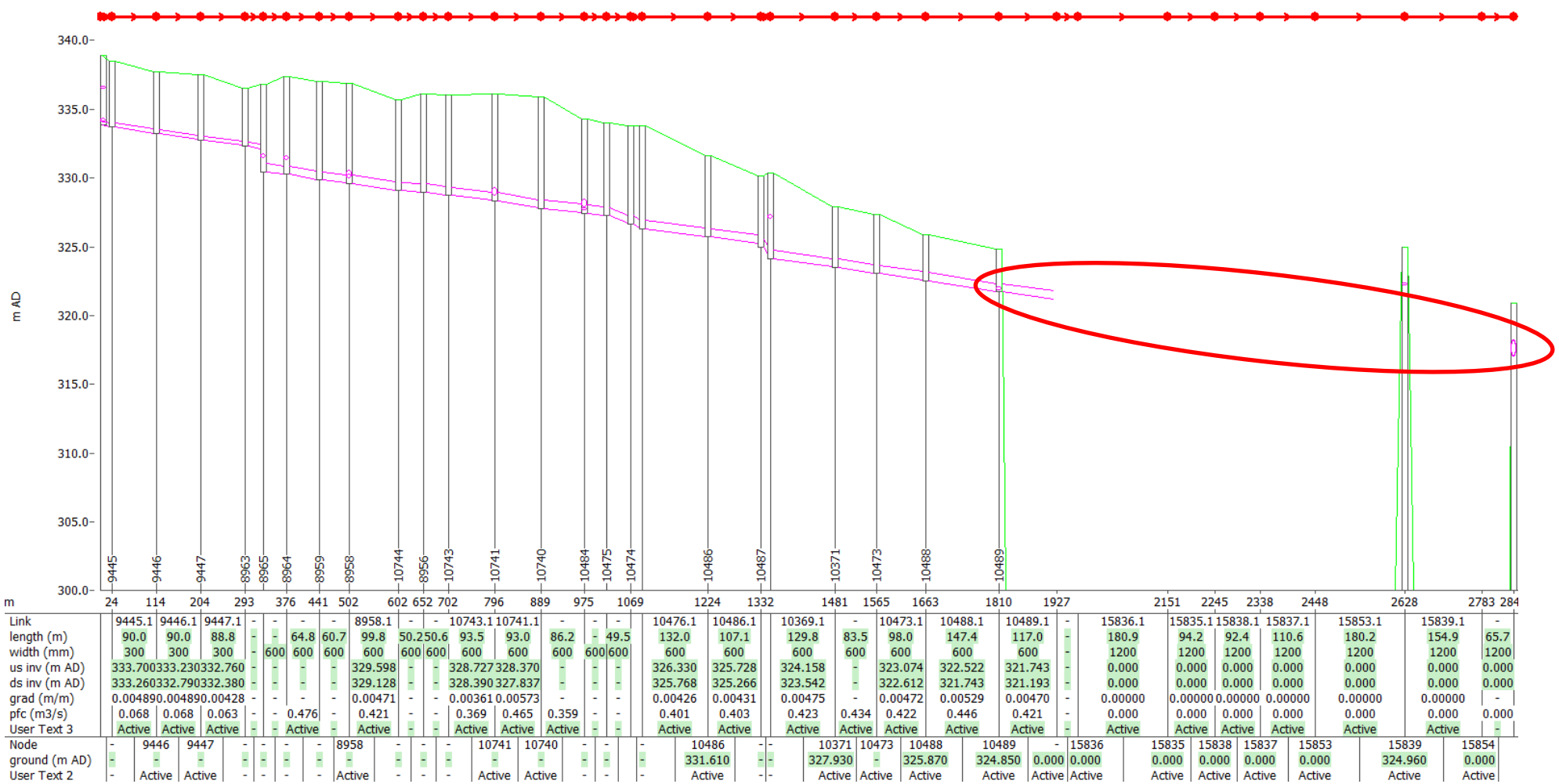
Figure No. 1

Title **CNR Trunk Geoplan Overview**

Client/Project City of Waterloo

Waterloo Sanitary Servicing Master Plan



m	24	114	204	293	376	441	502	602	652	702	796	889	975	1069	1224	1332	1481	1565	1663	1810	1927	2151	2245	2338	2448	2628	2783	284
Link	9445.1	9446.1	9447.1	-	-	-	-	8958.1	-	-	10743.1	10741.1	-	-	-	10476.1	10486.1	10369.1	-	10473.1	10488.1	10489.1	-	15836.1	15835.1	15838.1	15837.1	15853.1	15839.1	-
length (m)	90.0	90.0	88.8	-	-	64.8	60.7	99.8	50.2	50.6	93.5	93.0	86.2	-	49.5	132.0	107.1	129.8	83.5	98.0	147.4	117.0	-	180.9	94.2	92.4	110.6	180.2	154.9	65.7
width (mm)	300	300	300	-	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	-	1200	1200	1200	1200	1200	1200	1200
us inv (m AD)	333.700	333.230	332.760	-	-	-	-	329.598	-	-	328.727	328.370	-	-	-	326.330	325.728	324.158	-	323.074	322.522	321.743	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ds inv (m AD)	333.260	332.790	332.380	-	-	-	-	329.128	-	-	328.390	327.837	-	-	-	325.768	325.266	323.542	-	322.612	321.743	321.193	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000
grad (m/m)	0.00489	0.00489	0.00428	-	-	-	-	0.00471	-	-	0.00361	0.00573	-	-	-	0.00426	0.00431	0.00475	-	0.00472	0.00529	0.00470	-	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-
pfc (m3/s)	0.068	0.068	0.063	-	-	0.476	-	0.421	-	-	0.369	0.465	0.359	-	-	0.401	0.403	0.423	0.434	0.422	0.446	0.421	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000
User Text 3	Active	Active	Active	-	-	Active	-	Active	-	-	Active	Active	Active	-	-	Active	Active	Active	Active	Active	Active	Active	-	Active	Active	Active	Active	Active	Active	-
Node	-	9446	9447	-	-	-	-	8958	-	-	-	10741	10740	-	-	-	10486	-	-	10371	10473	10488	10489	-	15836	15835	15838	15837	15853	15839	15854
ground (m AD)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	331.610	-	-	327.930	-	325.870	324.850	0.000	0.000	0.000	0.000	0.000	0.000	324.960	0.000
User Text 2	-	Active	Active	-	-	-	-	Active	-	-	-	Active	Active	-	-	-	Active	-	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active

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Legend

Figure No. 1

Title **CNR Trunk Profile**

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Waterloo Sanitary Servicing Master Plan

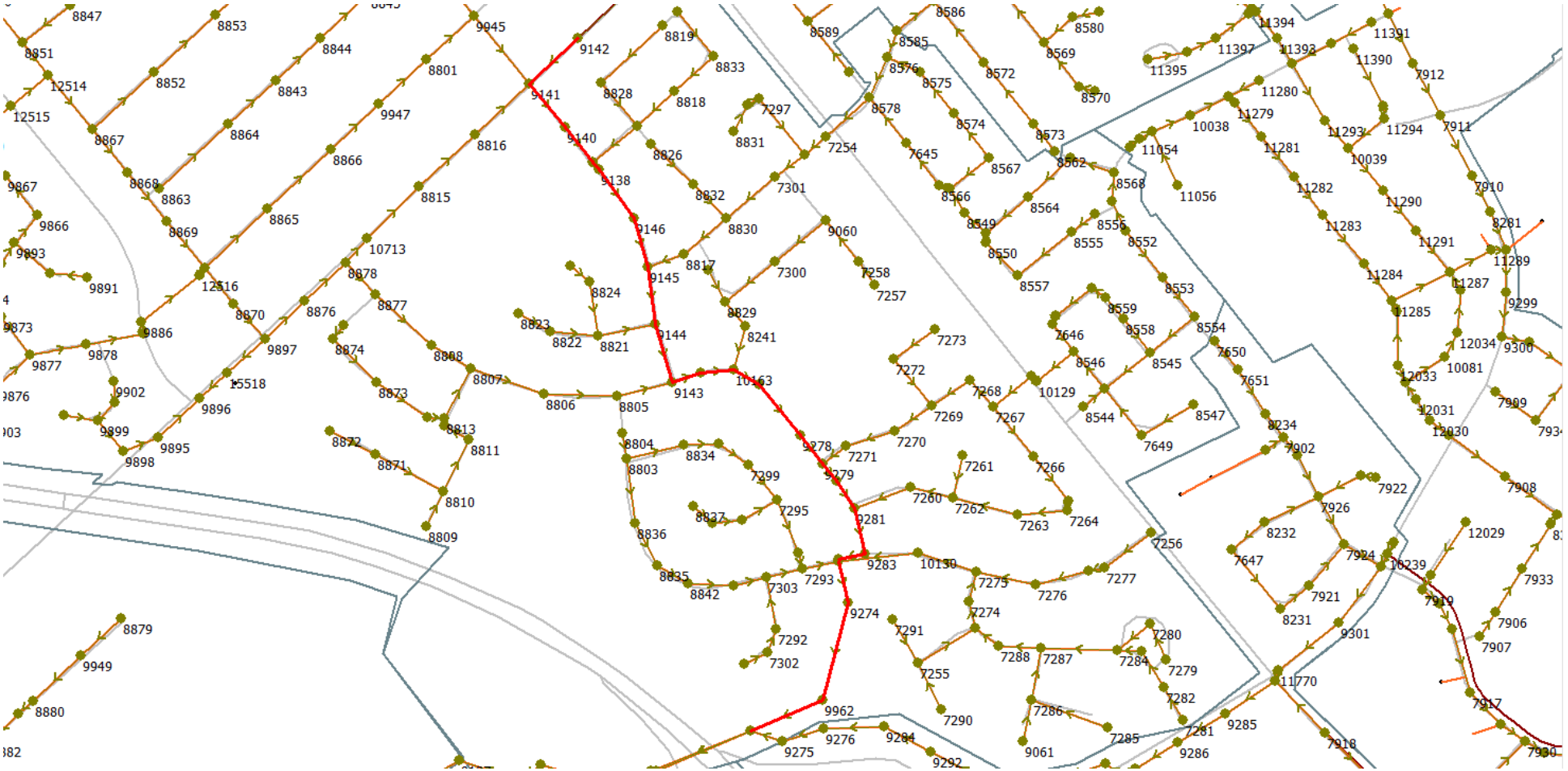

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Figure No. 1

Title **Colonial Trunk Geoplan Overview**

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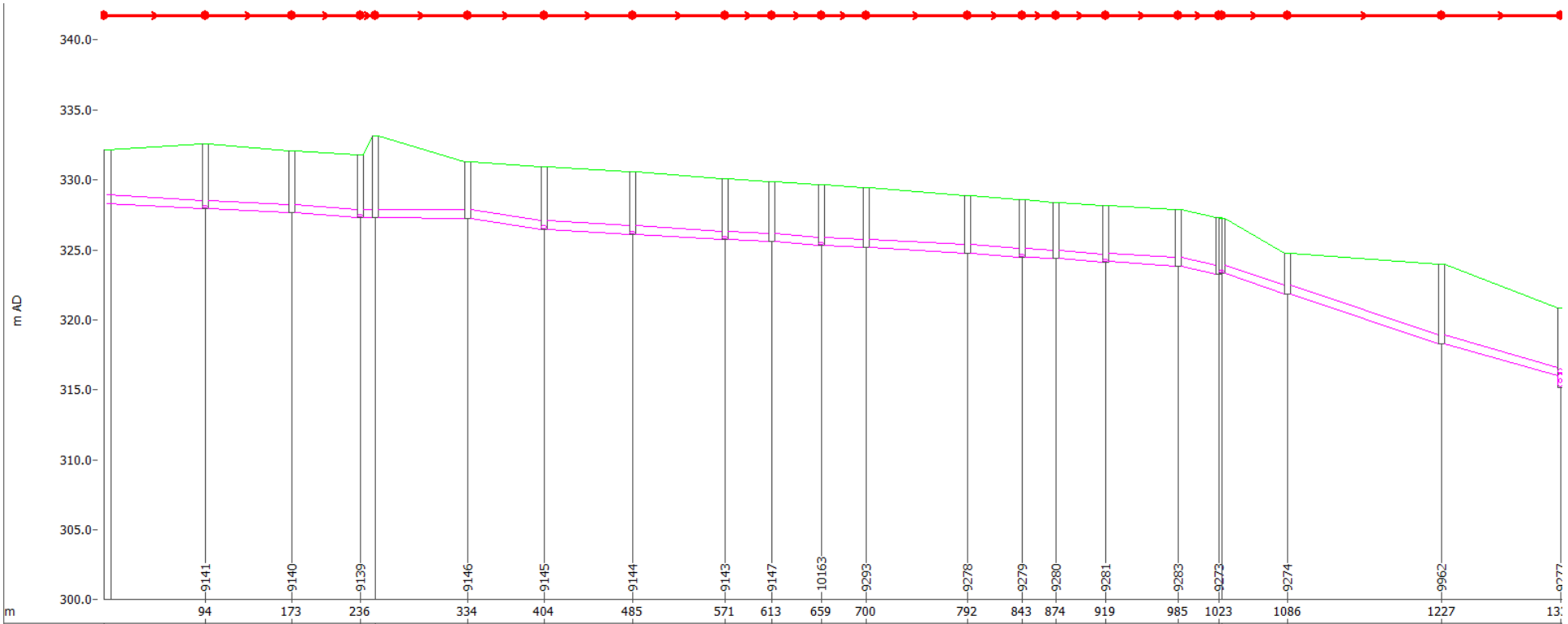

Link	9142.1	9141.1	9140.1	-	9138.1	9146.1	9145.1	9144.1	9143.1	9147.1	-	9293.1	9278.1	-	9280.1	9281.1	9283.1	9282.1	9274.1	9962.1
length (m)	93.5	79.6	62.6	-	84.4	70.6	80.8	85.4	42.8	45.6	41.0	92.4	50.4	31.0	45.2	66.5	37.8	59.9	141.3	109.9
width (mm)	600	600	600	-	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600
us inv (m AD)	328.340	327.950	327.640	-	327.300	327.260	326.480	326.120	325.750	325.600	-	325.190	324.770	-	324.390	324.170	-	323.320	321.860	318.300
ds inv (m AD)	327.950	327.640	327.320	-	327.260	326.480	326.120	325.750	325.600	325.330	-	324.780	324.490	-	324.110	323.850	-	321.860	318.300	316.020
grad (m/m)	0.00417	0.00390	0.00511	-	0.00047	0.01105	0.00446	0.00434	0.00351	0.00592	-	0.00444	0.00556	-	0.00619	0.00481	-	0.02438	0.02520	0.02076
pfc (m3/s)	0.397	0.383	0.439	-	0.134	0.646	0.410	0.404	0.364	0.473	0.359	0.409	0.458	0.349	0.483	0.426	0.741	0.959	0.975	0.885
User Text 3	Active	Active	Active	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active

Node	9142	9141	9140	9139	9138	9146	9145	9144	9143	9147	10163	9293	9278	9279	9280	9281	9283	-	-	9274	9962	9277
ground (m AD)	-	332.560	332.072	-	333.136	331.262	330.908	330.586	330.116	-	-	329.419	328.906	-	-	328.195	327.852	-	-	324.765	324.000	320.820
User Text 2	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	-	-	Active	Active	Active

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Figure No. 1

Title **Colonial Trunk Profile**

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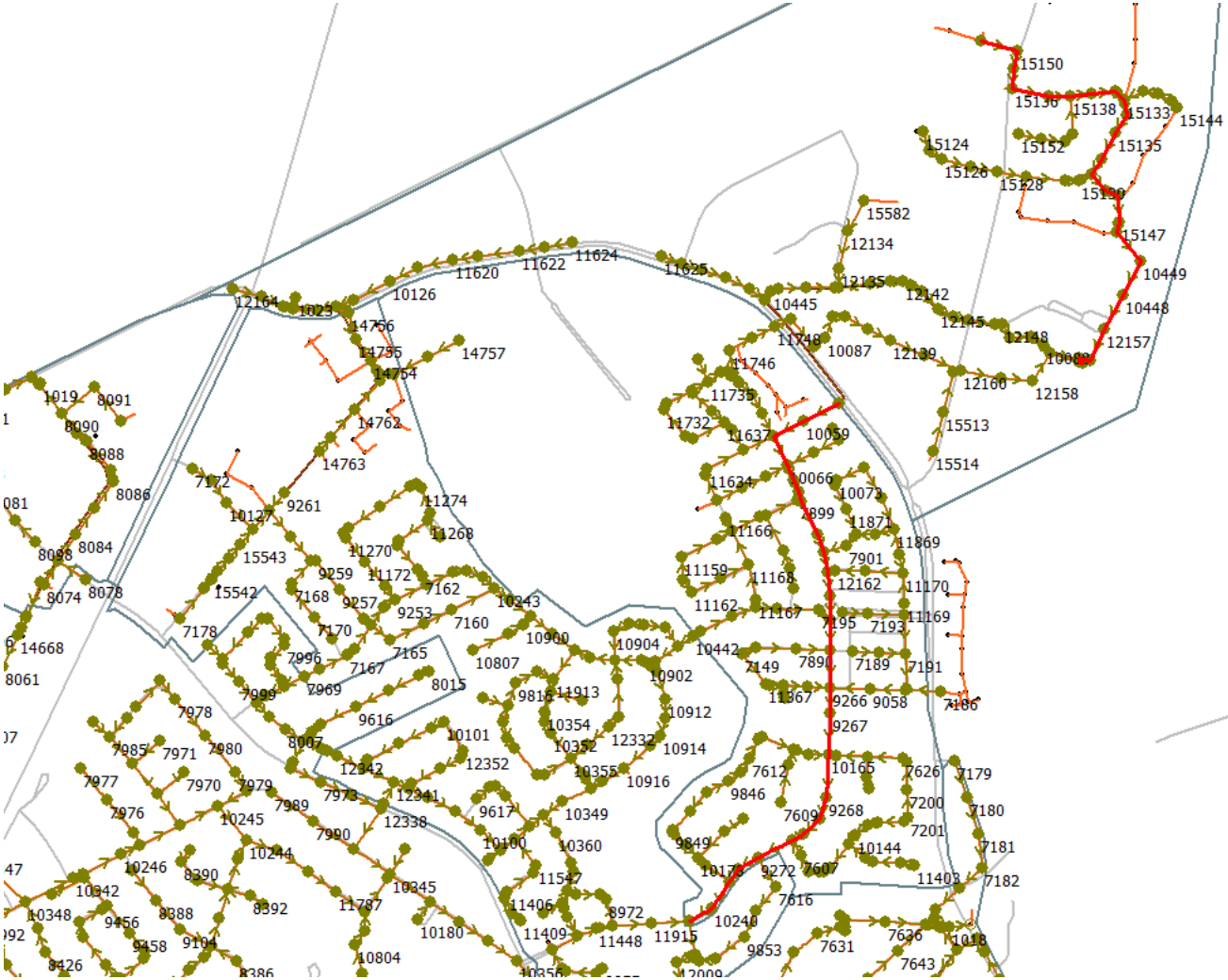

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Figure No. 1

Title **Eastbridge Trunk Geoplan Overview**

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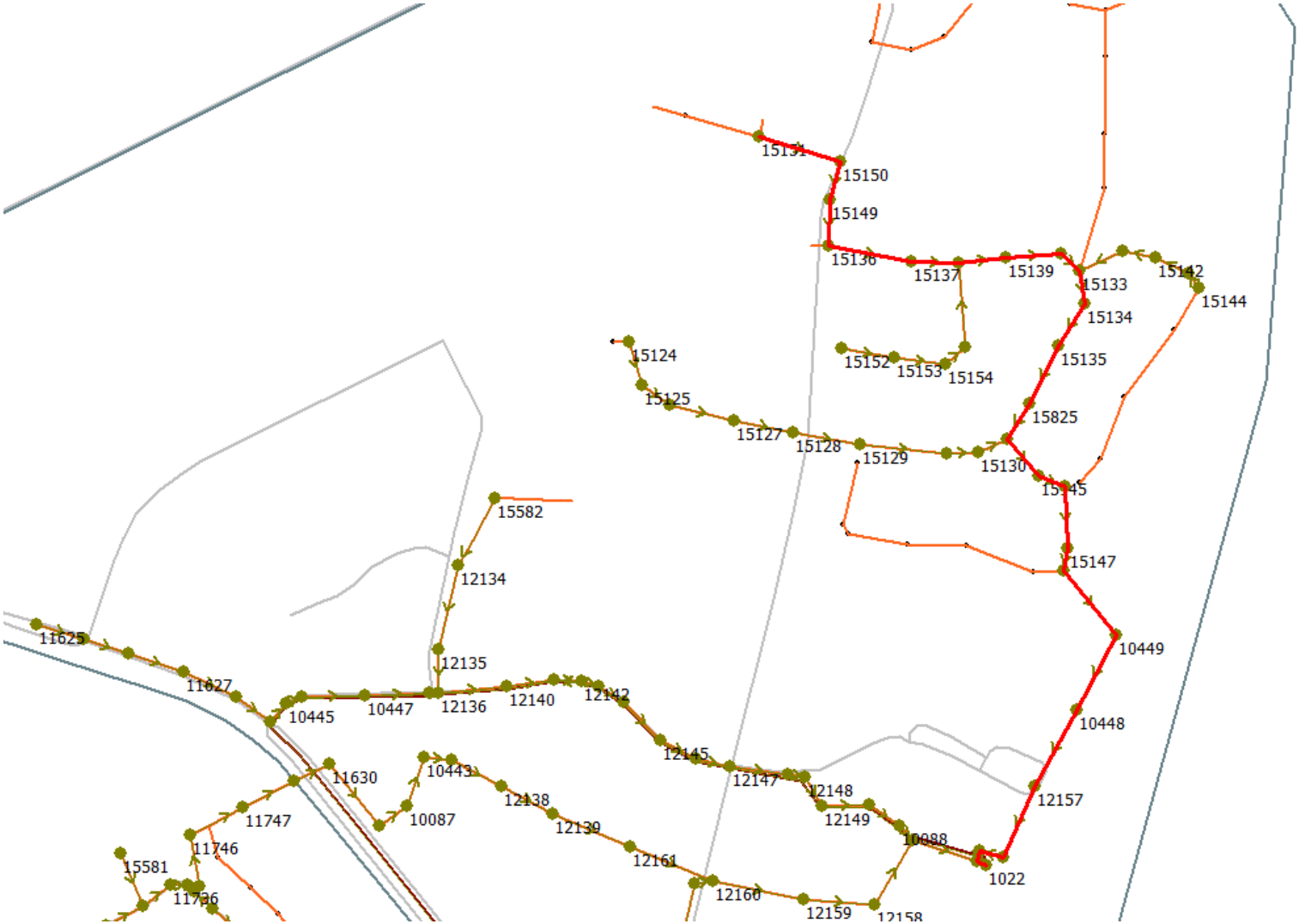

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Figure No. 1

Title **Eastbridge Profile 1 Overview**

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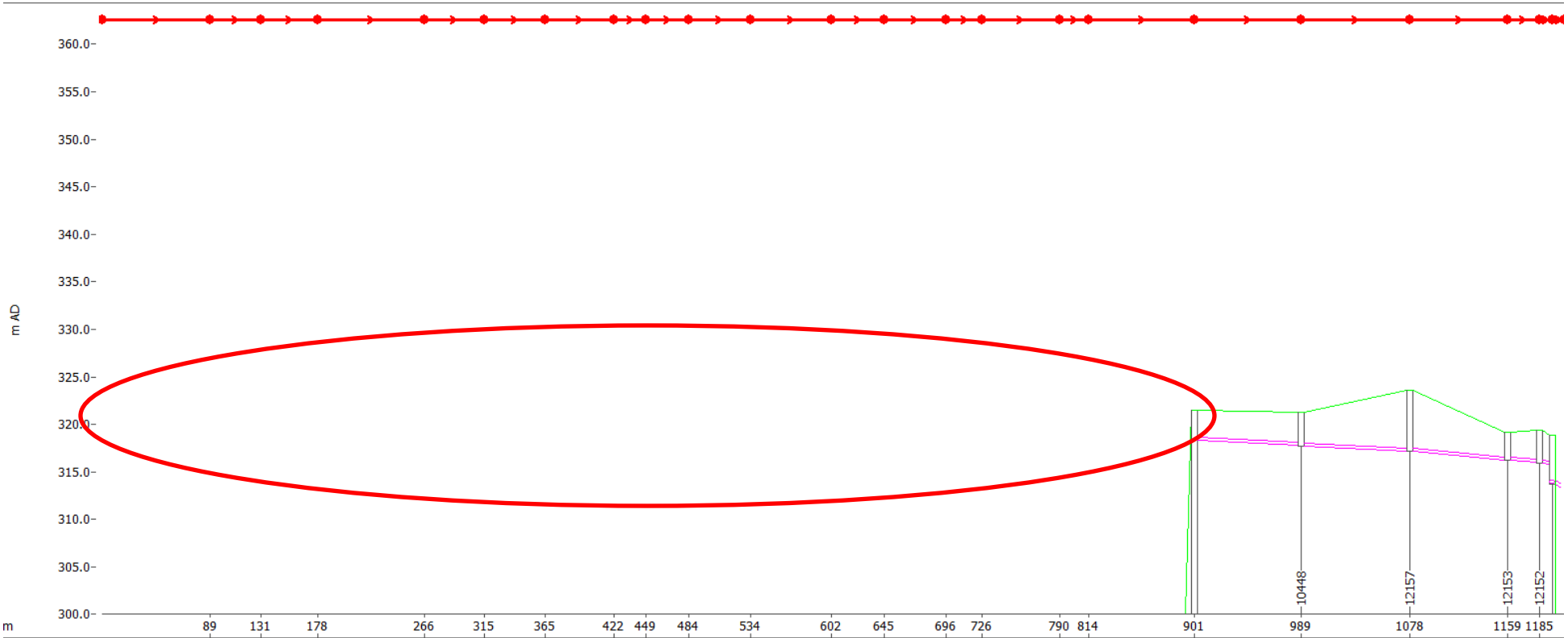

m		89	131	178		266	315	365	422	449	484		534		602	645	696	726		790	814		901		989		1078		1159	1185
Link	15151.1	15150.1	15149.1	15136.1	15137.1	15138.1	15139.1	-	-	15134.1	15135.1	15825.1	15131.1	-	15146.1	-	15148.1	10449.1	10448.1	12157.1	-	-
length (m)	88.9	42.1	47.3	88.0	49.0	49.7	57.0	26.8	34.8	50.9	67.3	43.2	50.9	30.0	64.1	23.5	87.3	88.0	89.7	80.6	26.2	-
width (mm)	300	300	300	300	300	300	300	300	375	375	375	375	375	375	375	375	375	300	300	300	300	-
us inv (m AD)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-	0.000	318.375	317.715	317.170	-	-
ds inv (m AD)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-	0.000	317.775	317.175	316.250	-	-
grad (m/m)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-	-	0.00000	0.00000	0.00000	0.00000	-	0.00000	-	0.00000	0.00682	0.00602	0.01141	-	-
pfc (m3/s)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-	0.000	0.080	0.075	0.103	0.089	-
User Text 3	Active	Active	Active	Active	Active	Active	Active	-	Active	Active	Active	Active	Active	Active	Active	-	Active	Active	Active	Active	-	-
Node	15151	15150	15149	15136	15137	15138	15139	15140	-	15134	15135	15825	15131	15145	15146	15147	15148	10449	10448	12157	12153	-
ground (m AD)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	321.491	321.252	323.630	319.130	-
User Text 2	Active	Active	Active	Active	Active	Active	Active	Active	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	-

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Figure No. 1

Title **Eastbridge Trunk Profile 1**

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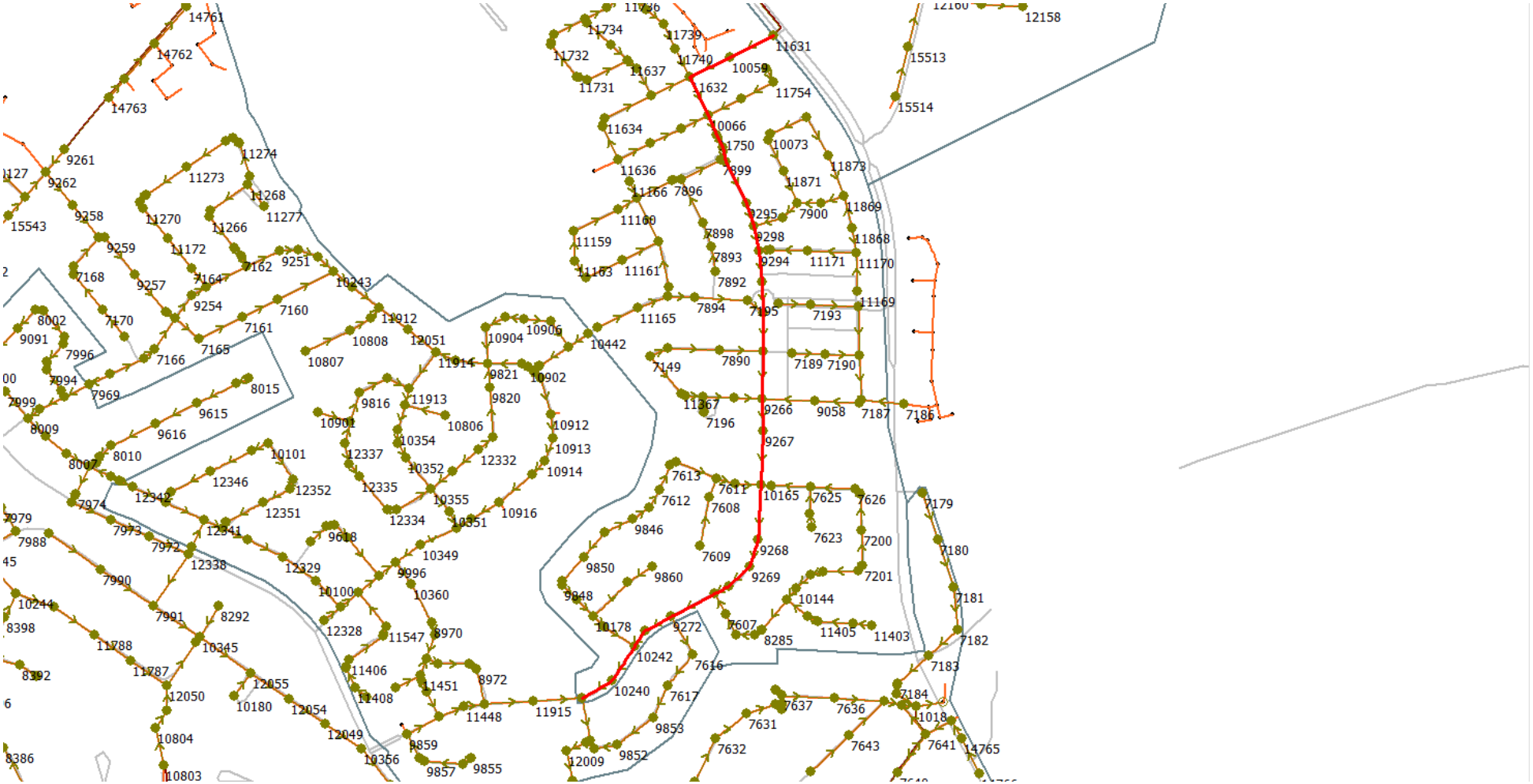

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Figure No. 1

Title **Eastbridge Profile 2 Overview**

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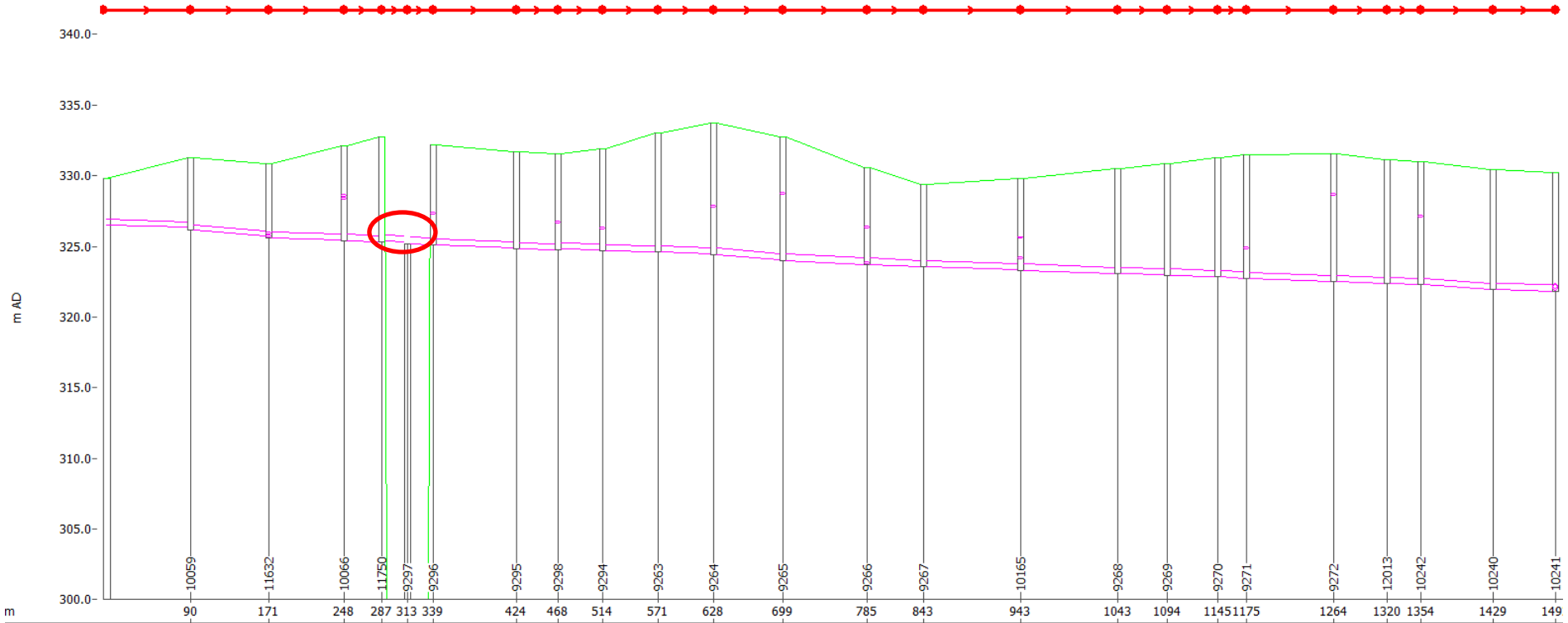

Link	11631.1	10059.1	11632.1	-	-	-	9296.1	9295.1	9298.1	9294.1	9263.1	9264.1	9265.1	9266.1	9267.1	10165.1	9268.1	9269.1	-	9271.1	9272.2	-	10242.1	10240.1	
length (m)	89.8	80.9	77.5	38.4	26.6	25.9	85.3	43.6	45.9	56.6	57.2	70.8	86.6	58.4	99.1	100.0	51.4	51.5	29.6	89.4	55.2	34.5	74.6	63.5	
width (mm)	375	375	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	
us inv (m AD)	326.548	326.143	325.573	-	-	-	325.111	-	-	324.696	324.619	324.433	324.008	323.719	323.547	323.320	323.076	322.965	-	322.730	322.500	-	322.279	321.960	
ds inv (m AD)	326.348	325.735	325.434	-	-	-	324.875	-	-	324.626	324.450	324.029	323.730	323.559	323.352	323.065	322.993	322.859	-	322.500	322.366	-	321.960	321.840	
grad (m/m)	0.00223	0.00505	0.00179	-	-	-	0.00277	-	-	0.00124	0.00295	0.00570	0.00321	0.00274	0.00197	0.00255	0.00161	0.00206	-	0.00257	0.00243	-	0.00428	0.00189	
pfc (m3/s)	0.083	0.125	0.121	0.128	-	-	0.150	0.137	0.134	0.100	0.155	0.215	0.162	0.149	0.127	0.144	0.115	0.129	-	0.145	0.141	0.143	0.187	0.124	
User Text 3	Active	Active	Active	Active	-	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	-	Active	Active	Active	Active	Active	
Node	11631	10059	11632	10066	-	-	9296	9295	9298	9294	9263	9264	9265	9266	9267	10165	9268	9269	9270	9271	9272	12013	10242	10240	-
ground (m AD)	-	331.260	330.890	332.090	-	-	332.158	331.730	-	-	333.023	333.740	332.728	330.578	329.364	329.801	330.516	-	-	331.465	331.528	-	331.017	330.412	-
User Text 2	Active	Active	Active	Active	-	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	-	Active	Active	Active	Active	Active	-

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Figure No. 1

Title **Eastbridge Trunk Profile 2**

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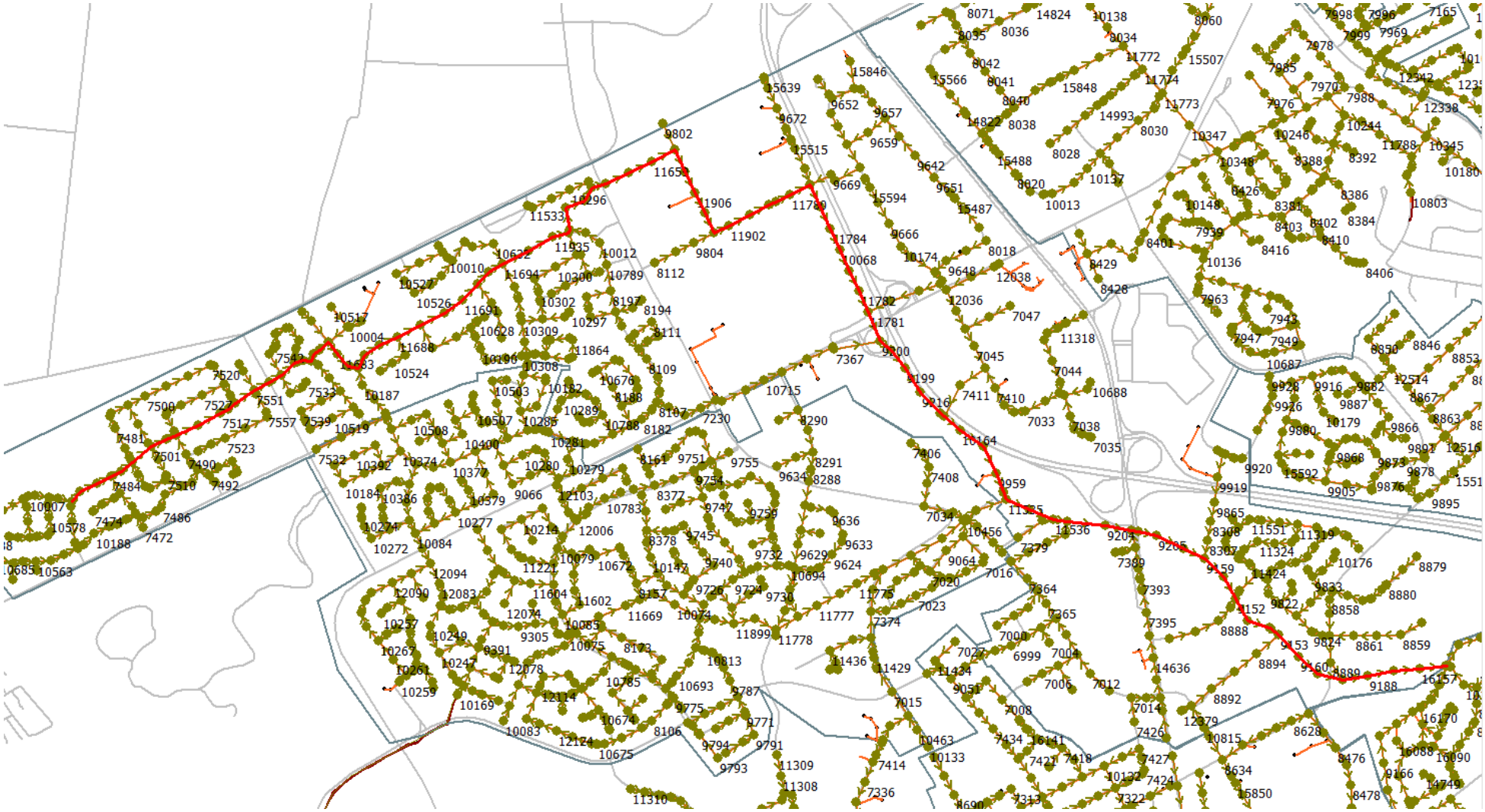

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Figure No. 1

Title **Forwell Trunk Geoplan Overview**

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Figure No. 2

Title **Forwell Trunk Profile 1 Overview**

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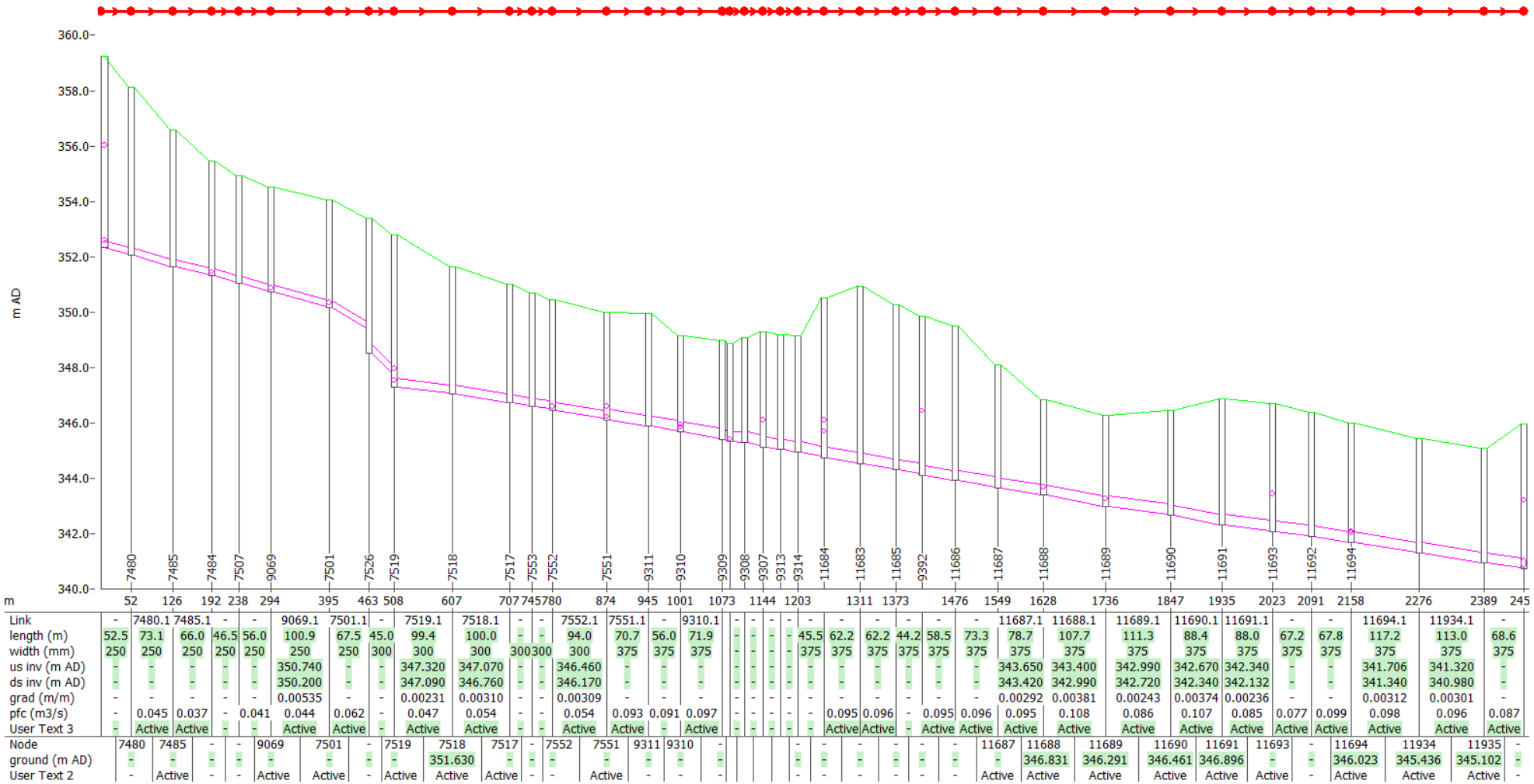
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344.0
342.0
340.0
7480 7485 7484 7507 9069 7501 7526 7519 7518 7517 7553 7552 7551 9311 9310 9309 9308 9307 9313 9314 11684 11683 11685 9392 11686 11687 11688 11689 11690 11691 11693 11692 11694

m

| | | |

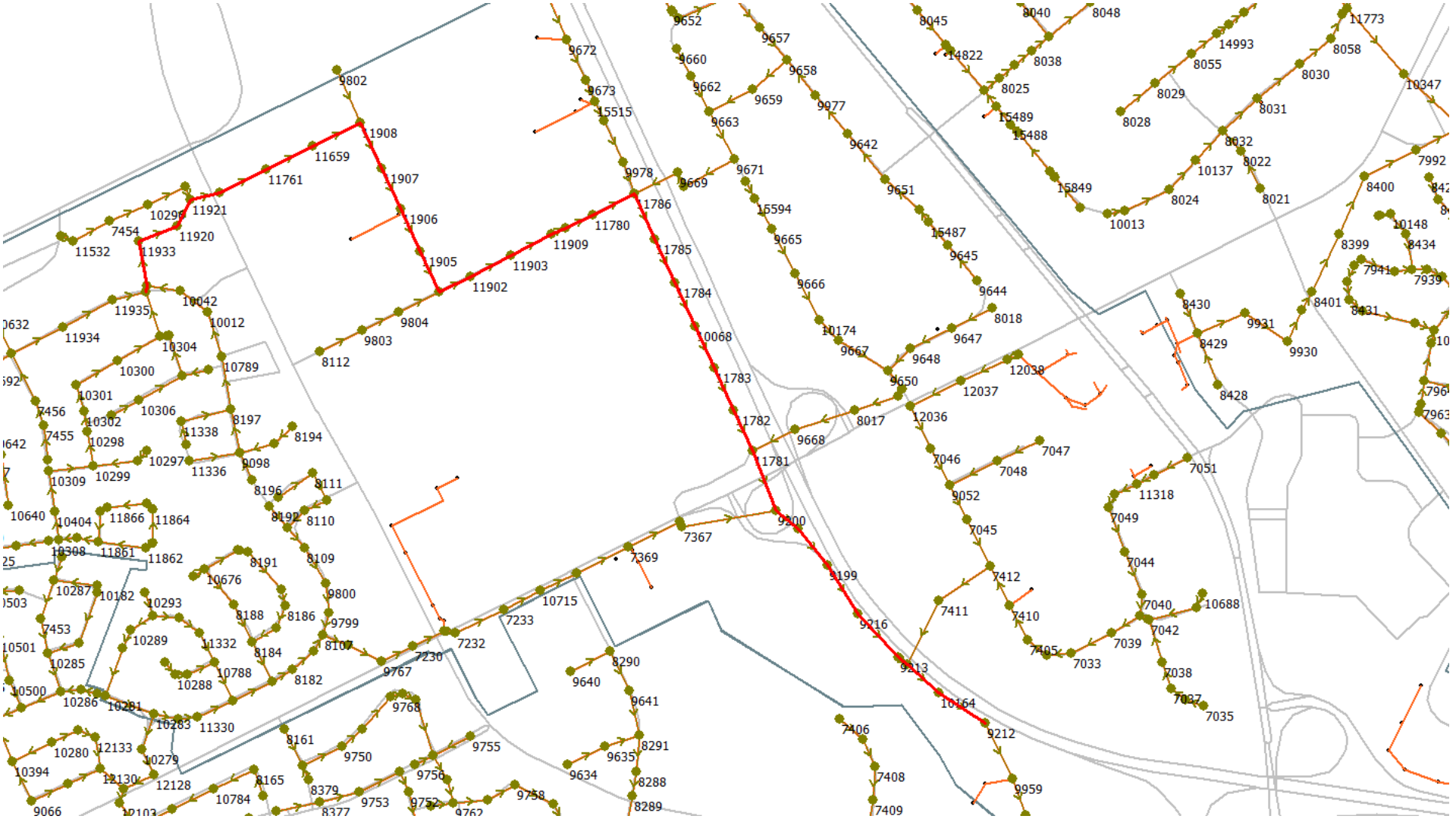

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Figure No. 4

Title **Forwell Trunk Profile 2 Overview**

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Waterloo Sanitary Servicing Master Plan

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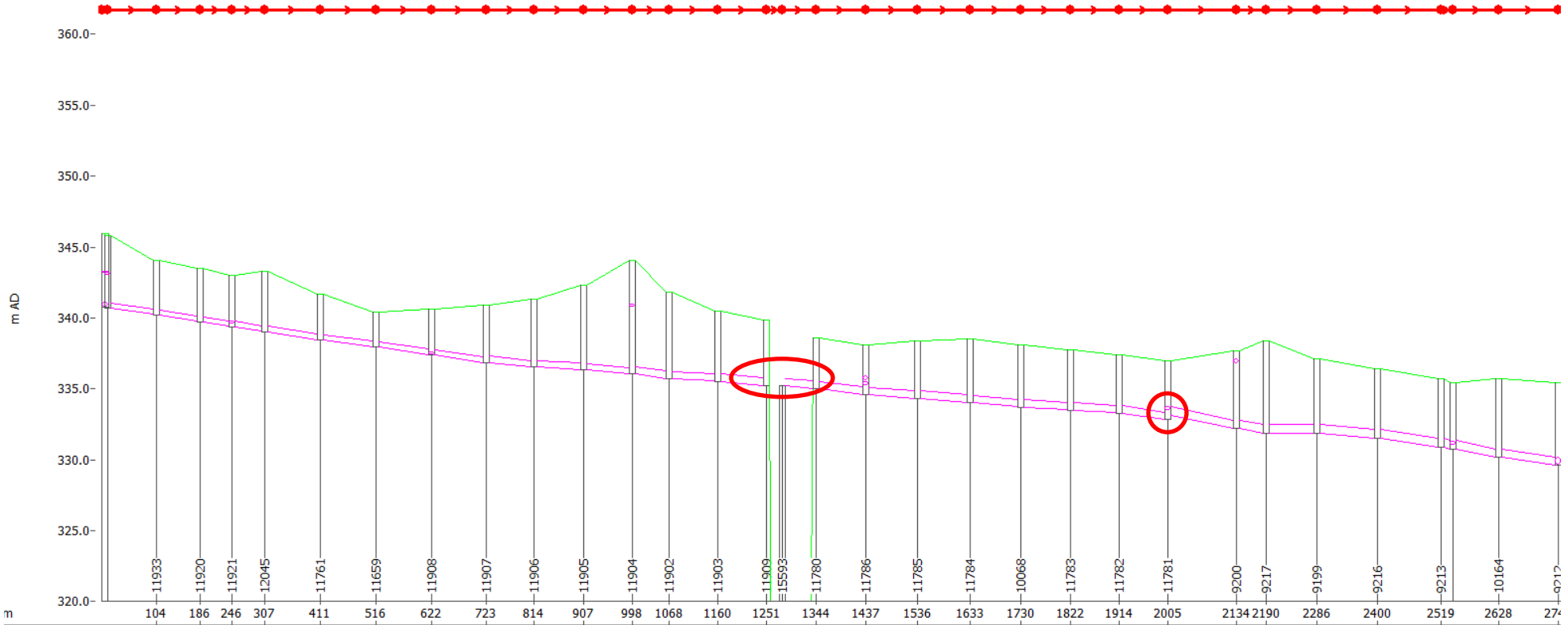
360.0
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m AD
11933
11920
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11761
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9213
10164
m
104
186
246
307
411
516
622
723
814
907
998
1068
1160
1251
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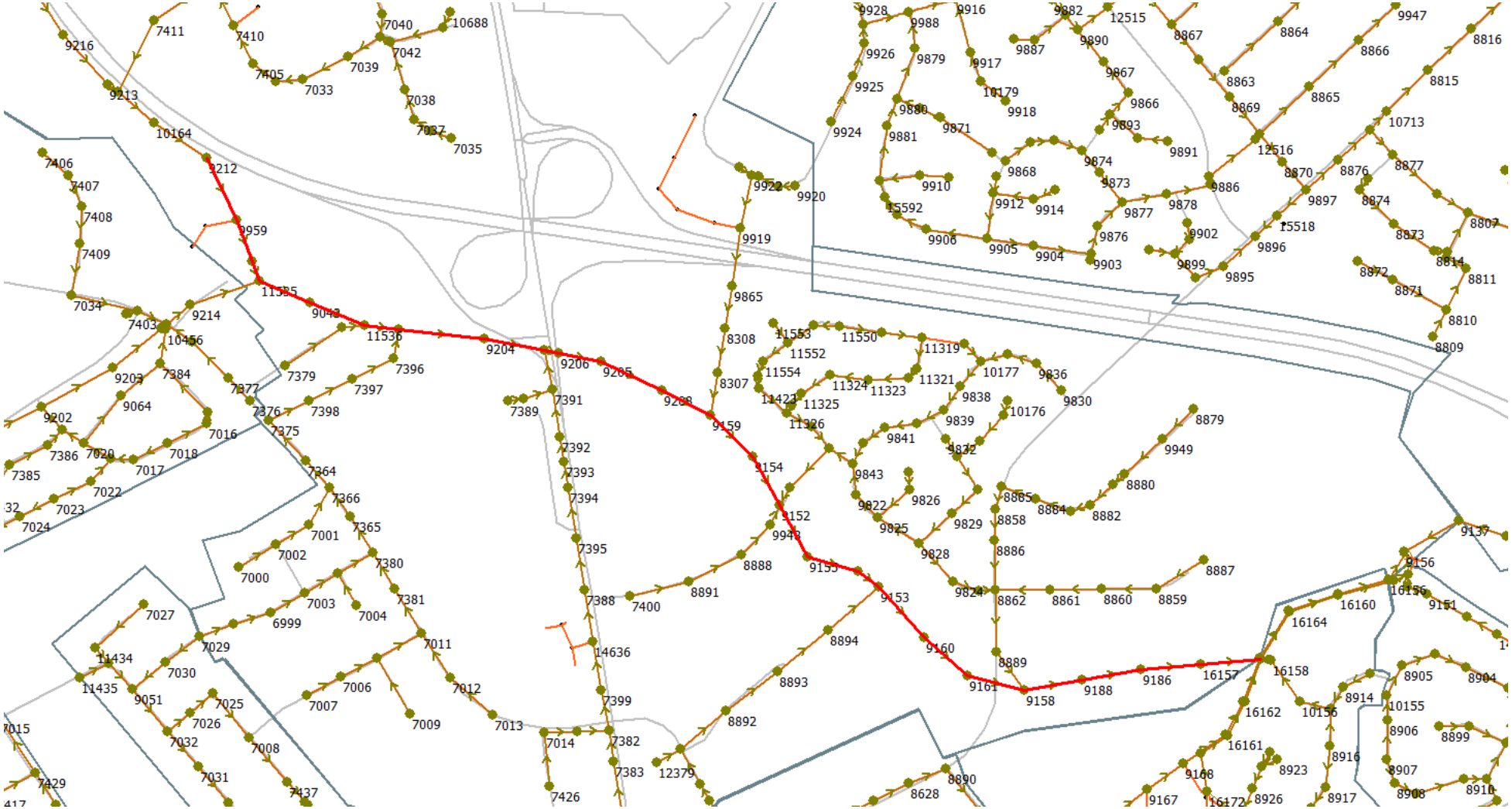

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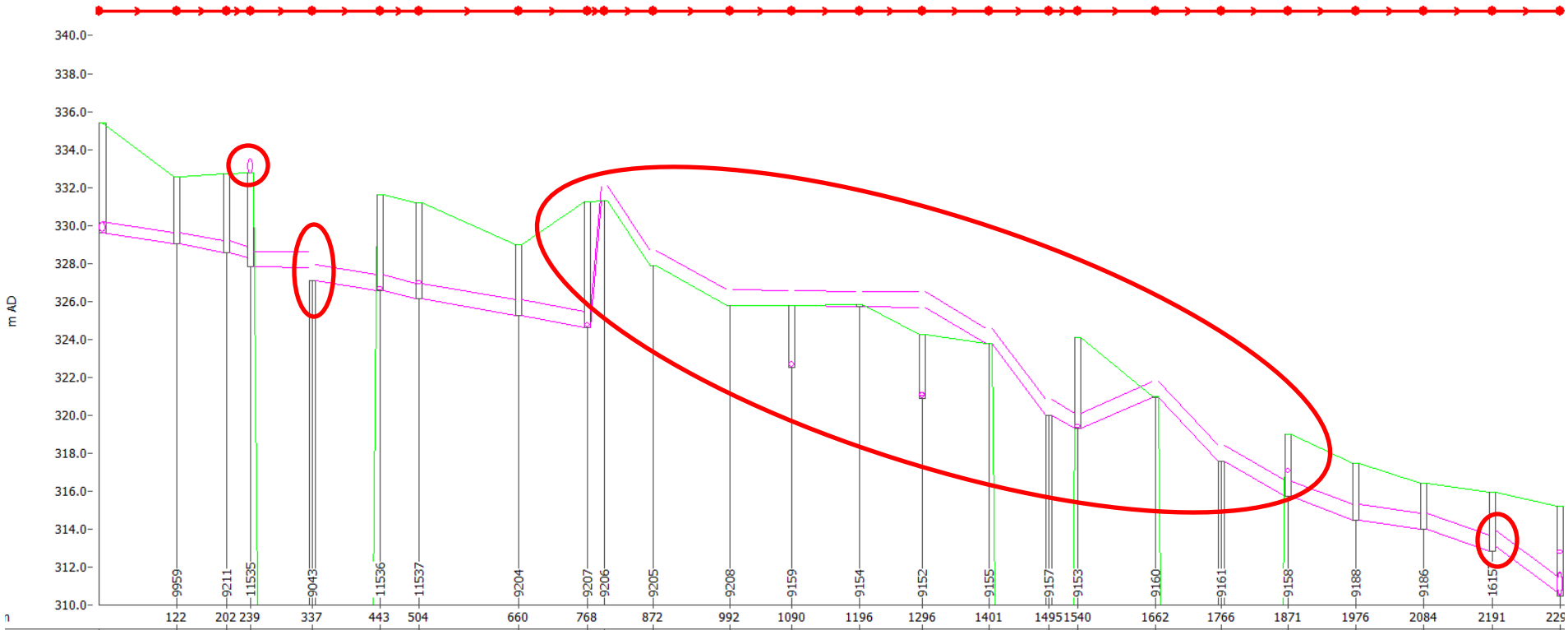
Figure No. 6

Title **Forwell Trunk Profile 3 Overview**

Client/Project City of Waterloo

Waterloo Sanitary Servicing Master Plan



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length (m)	122.4	79.4	-	98.0	106.4	60.7	155.8	108.5	-	77.1	119.8	97.4	106.7	99.7	104.8	94.2	45.0	121.6	104.4	104.7	105.5	107.4	107.7	107.3
width (mm)	600	600	600	825	825	825	825	825	-	825	825	825	825	825	825	825	825	825	825	825	825	825	825	825
us inv (m AD)	329.610	329.040	-	327.820	327.100	-	326.130	325.270	-	331.290	327.870	325.780	325.770	325.710	325.680	323.770	-	319.300	320.980	317.600	315.740	314.500	314.040	313.130
ds inv (m AD)	329.040	328.580	-	327.800	326.590	-	325.270	324.650	-	327.870	325.780	325.770	325.710	325.680	323.770	320.000	-	320.980	317.600	315.750	314.500	314.040	312.880	310.735
grad (m/m)	0.00466	0.00580	-	0.00020	0.00479	-	0.00552	0.00572	-	0.04435	0.01745	0.00010	0.00056	0.00030	0.01822	0.04002	-	-0.01382	0.03237	0.01766	0.01175	0.00428	0.01077	0.02233
pfc (m3/s)	0.419	0.468	-	0.205	0.994	1.237	1.067	1.086	-	3.023	1.897	0.145	0.340	0.249	1.938	2.872	-	-1.688	2.583	1.908	1.556	0.940	1.490	2.145
User Text 3	Active	Active	-	Active	Active	Active	Active	Active	-	Active	Active	Active	Active	Active	Active	Active	-	Active	Active	Active	Active	Active	Active	Active

Node	9212	9959	9211	11535	9043	11536	11537	9204	9207	-	9205	9208	9159	9154	9152	9155	9157	9153	9160	9161	9158	9188	9186	16157	-
ground (m AD)	-	332.578	-	-	0.000	331.610	331.210	328.989	-	-	327.879	325.781	325.774	325.865	324.254	323.770	0.000	324.093	320.989	0.000	318.990	317.461	316.445	315.970	-
User Text 2	-	Active	-	Active	Active	Active	Active	Active	Active	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	-

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Figure No. 7

Title **Forwell Trunk – Profile 3**

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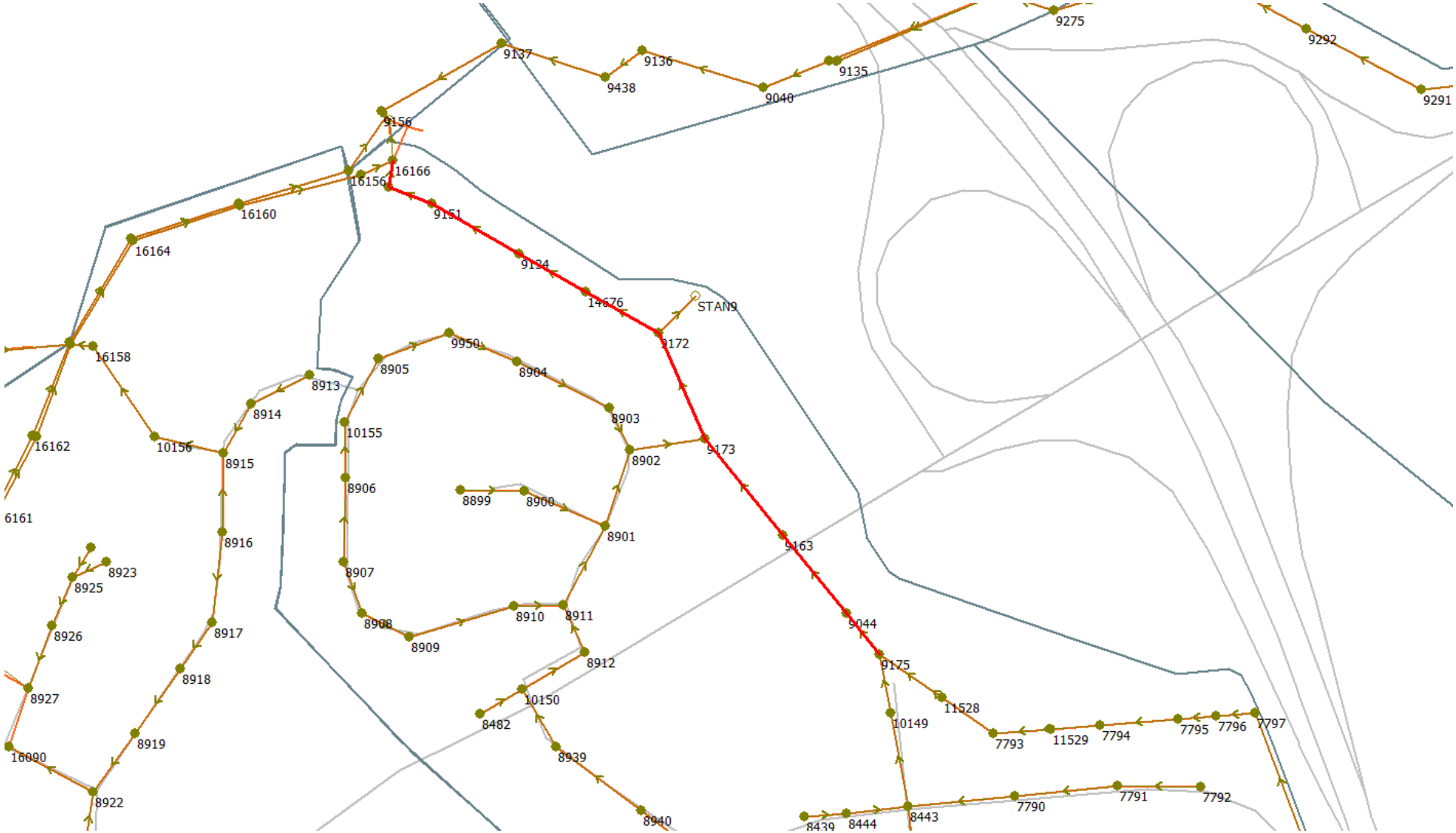
Client/Project City of Waterloo

Waterloo Sanitary Servicing Master Plan

Drawing is not to be used for construction



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Legend

Figure No. 1

Title **Glenridge Trunk Geoplan Overview**

Stantec Consulting Ltd.
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Kitchener, Ontario, Canada
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Fax: (519) 579-6733
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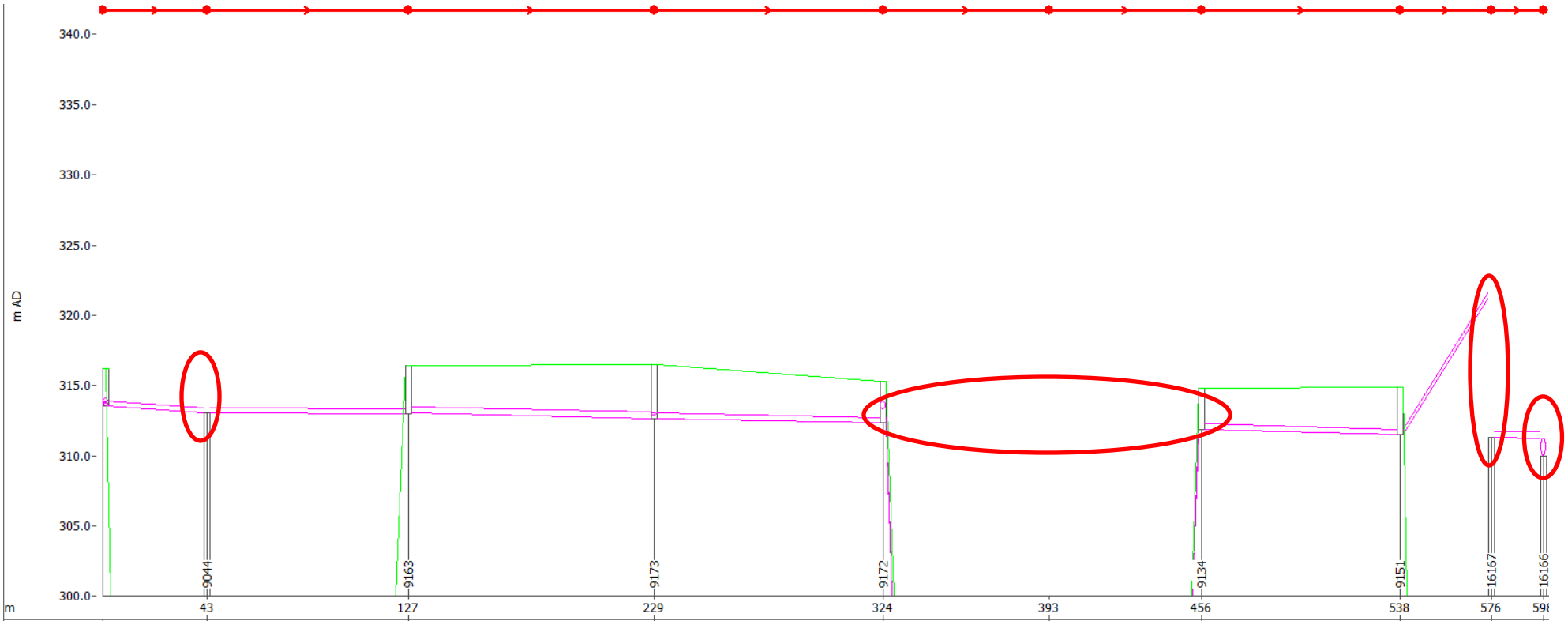

Link	9175.1	9044.1	9163.1	9173.1	9172.2	14676.1	9134.1	9151.1	16167.1	
length (m)	43.5	83.5	101.9	94.8	69.1	63.0	82.4	38.1	21.6	
width (mm)	350	350	450	400	400	400	400	400	450	
us inv (m AD)	313.580	313.050	313.055	312.651	312.336	0.000	311.880	311.490	311.290	
ds inv (m AD)	313.055	313.000	312.651	312.336	0.000	311.880	311.490	321.290	311.250	
grad (m/m)	0.01207	0.00060	0.00396	0.00332	4.52068	-4.94685	0.00474	-0.25745	0.00185	
pfc (m3/s)	0.160	0.036	0.180	0.120	4.429	-4.633	0.143	-1.057	0.123	
User Text 3	Active	Active	Active	Active	Active	Active	Active	Active	Active	
Node	9175	9044	9163	9173	9172	14676	9134	9151	16167	-
ground (m AD)	316.190	0.000	316.455	316.501	315.286	0.000	314.800	314.878	0.000	-
User Text 2	Active	Active	Active	Active	Active	Active	Active	Active	Active	-

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Figure No. 1

Title **Glenridge Trunk – Profile**

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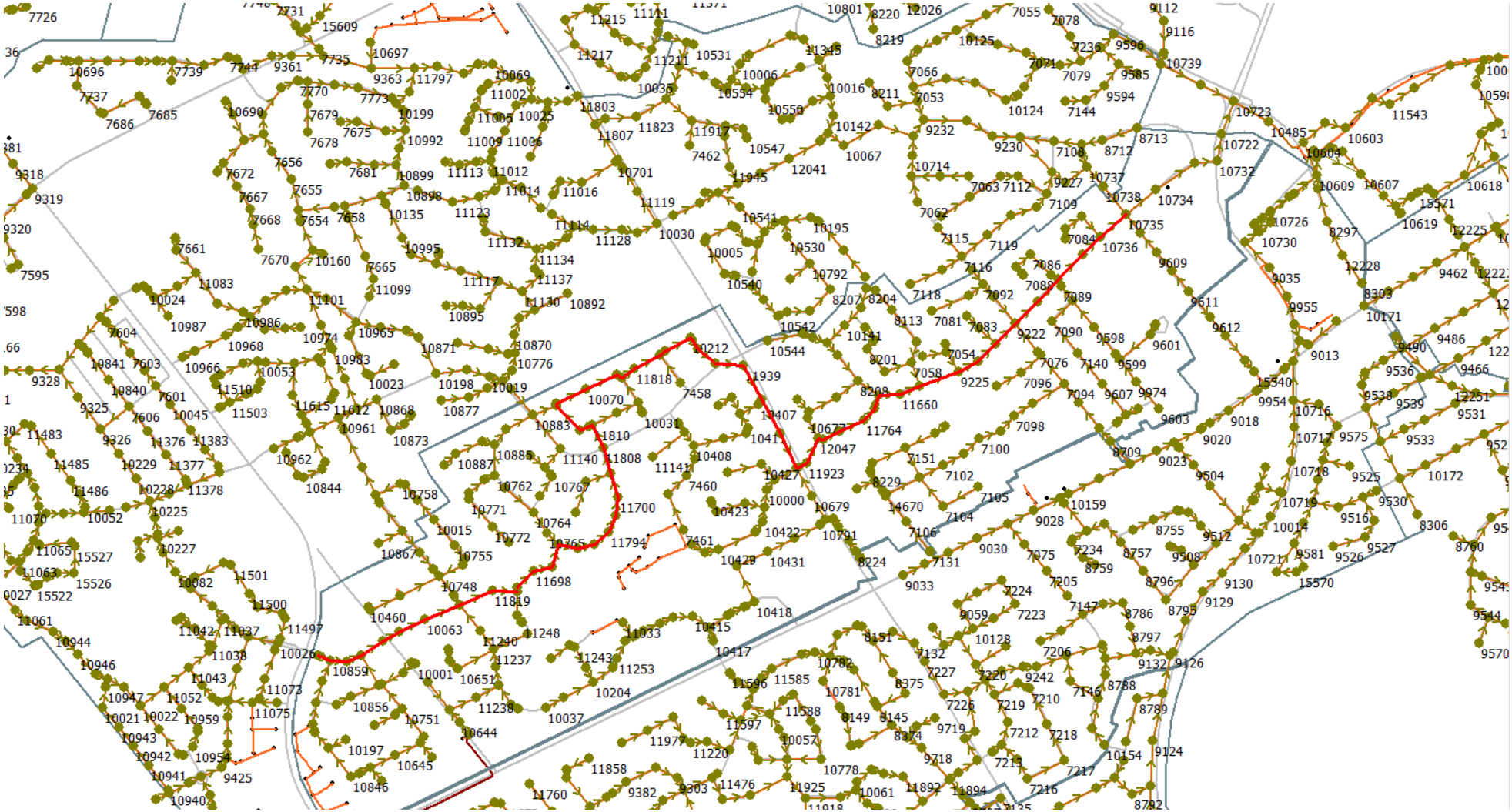

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Figure No. 1

Title **Keats Trunk Geoplan Overview**

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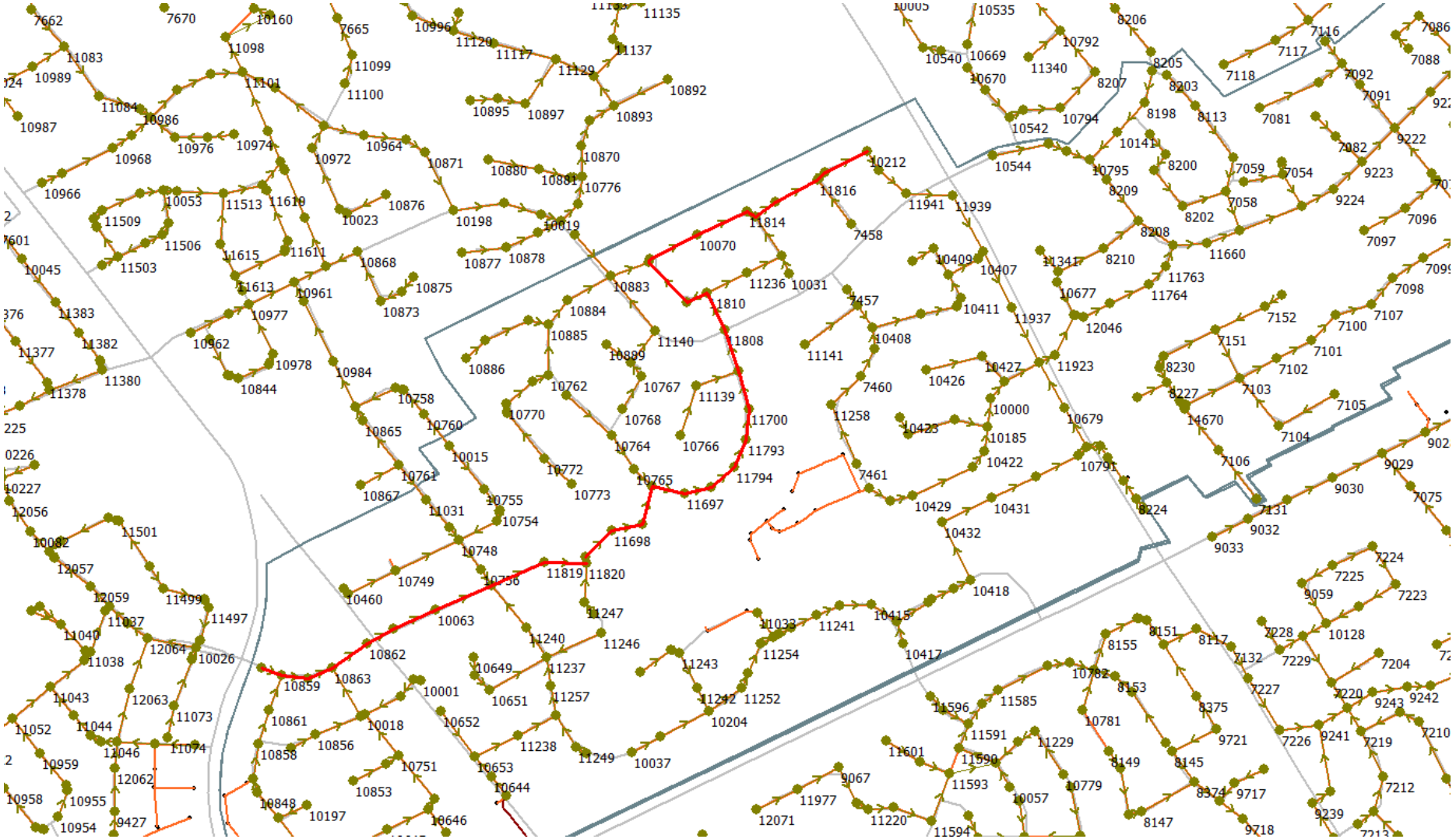

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Figure No. 1

Title **Keats Trunk Profile 1 Overview**

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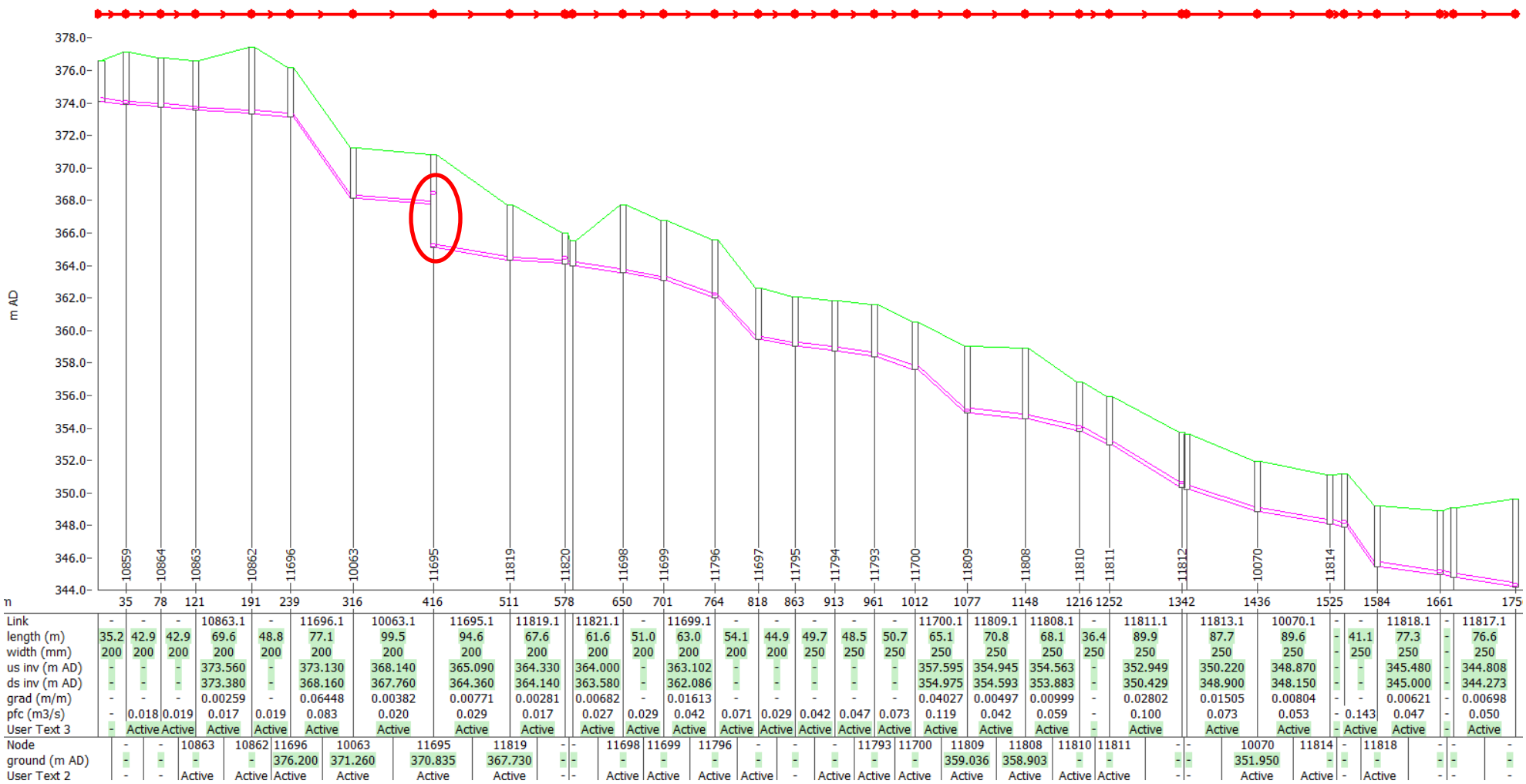

n	35	78	121	191	239	316	416	511	578	650	701	764	818	863	913	961	1012	1077	1148	1216	1252	1342	1436	1525	1584	1661	175
Link	-	-	-	10863.1	-	11696.1	10063.1	11695.1	11819.1	11821.1	-	11699.1	-	-	-	-	-	11700.1	11809.1	11808.1	-	11811.1	11813.1	10070.1	-	-	11818.1	-	11817.1
length (m)	35.2	42.9	42.9	69.6	48.8	77.1	99.5	94.6	67.6	61.6	51.0	63.0	54.1	44.9	49.7	48.5	50.7	65.1	70.8	68.1	36.4	89.9	87.7	89.6	-	41.1	77.3	-	76.6
width (mm)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	250	250	250	250	250	250	250	250	250	250	-	250	250	-	250
us inv (m AD)	-	-	-	373.560	-	373.130	368.140	365.090	364.330	364.000	-	363.102	-	-	-	-	-	357.595	354.945	354.563	-	352.949	350.220	348.870	-	-	345.480	-	344.808
ds inv (m AD)	-	-	-	373.380	-	368.160	367.760	364.360	364.140	363.580	-	362.086	-	-	-	-	-	354.975	354.593	353.883	-	350.429	348.900	348.150	-	-	345.000	-	344.273
grad (m/m)	-	-	-	0.00259	-	0.06448	0.00382	0.00771	0.00281	0.00682	-	0.01613	-	-	-	-	-	0.04027	0.00497	0.00999	-	0.02802	0.01505	0.00804	-	-	0.00621	-	0.00698
pfc (m3/s)	-	0.018	0.019	0.017	0.019	0.083	0.020	0.029	0.017	0.027	0.029	0.042	0.071	0.029	0.042	0.047	0.073	0.119	0.042	0.059	-	0.100	0.073	0.053	-	0.143	0.047	-	0.050
User Text 3	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	-	Active	Active	Active	-	Active	Active	-	Active
Node	-	-	10863	10862	11696	10063	11695	11819	-	-	11698	11699	11796	-	-	-	11793	11700	11809	11808	11810	11811	-	10070	11814	-	11818	-	-	-
ground (m AD)	-	-	-	-	376.200	371.260	370.835	367.730	-	-	-	-	-	-	-	-	-	-	359.036	358.903	-	-	-	351.950	-	-	-	-	-	-
User Text 2	-	-	Active	Active	Active	Active	Active	Active	-	-	Active	Active	Active	Active	-	Active	Active	Active	Active	Active	Active	Active	-	Active	Active	-	Active	-	-	-

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Figure No. 1

Title **Keats Trunk – Profile 1**

Client/Project City of Waterloo

Waterloo Sanitary Servicing Master Plan

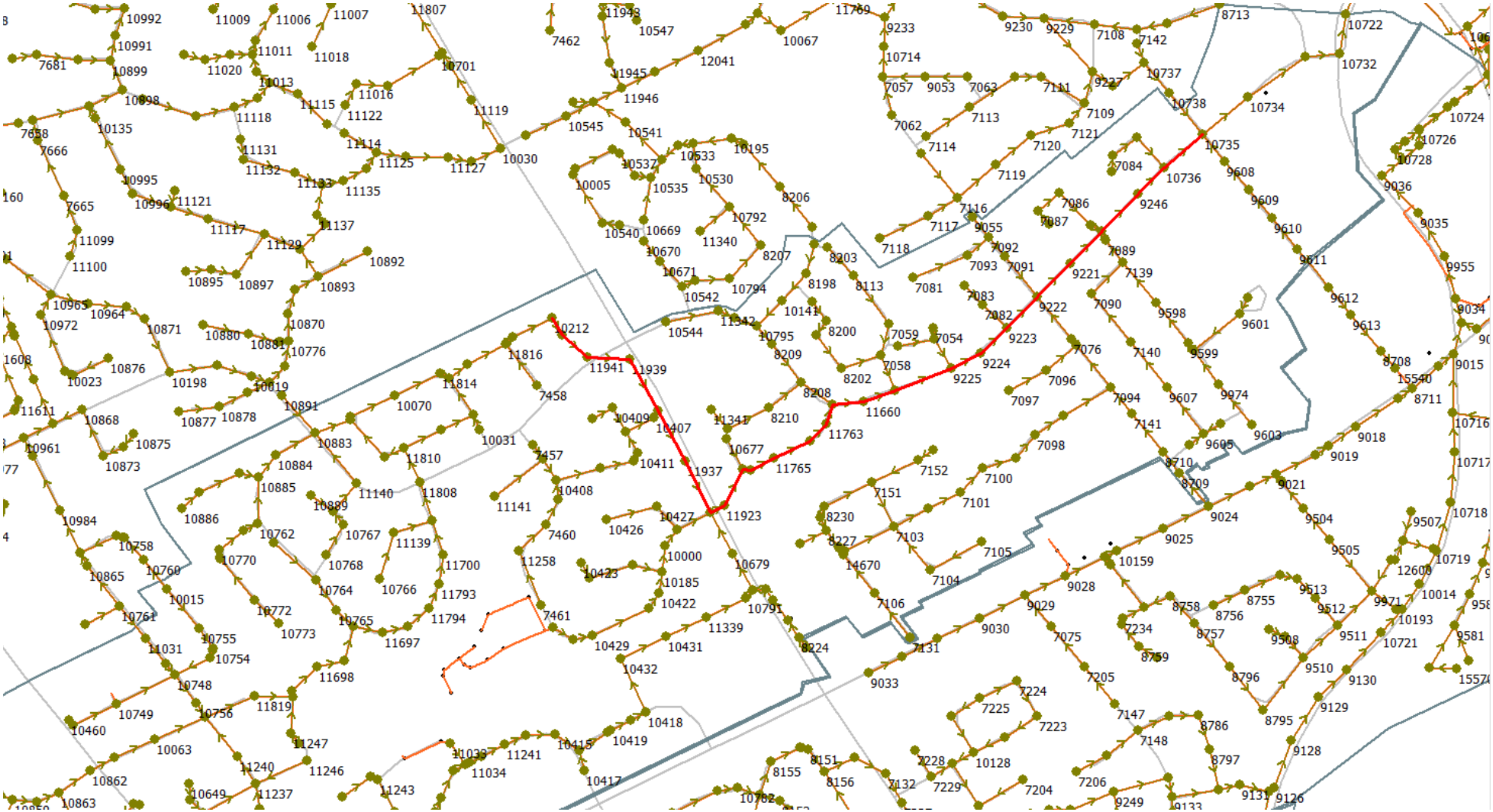

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Figure No. 1

Title **Keats Trunk Profile 2 Overview**

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Client/Project City of Waterloo

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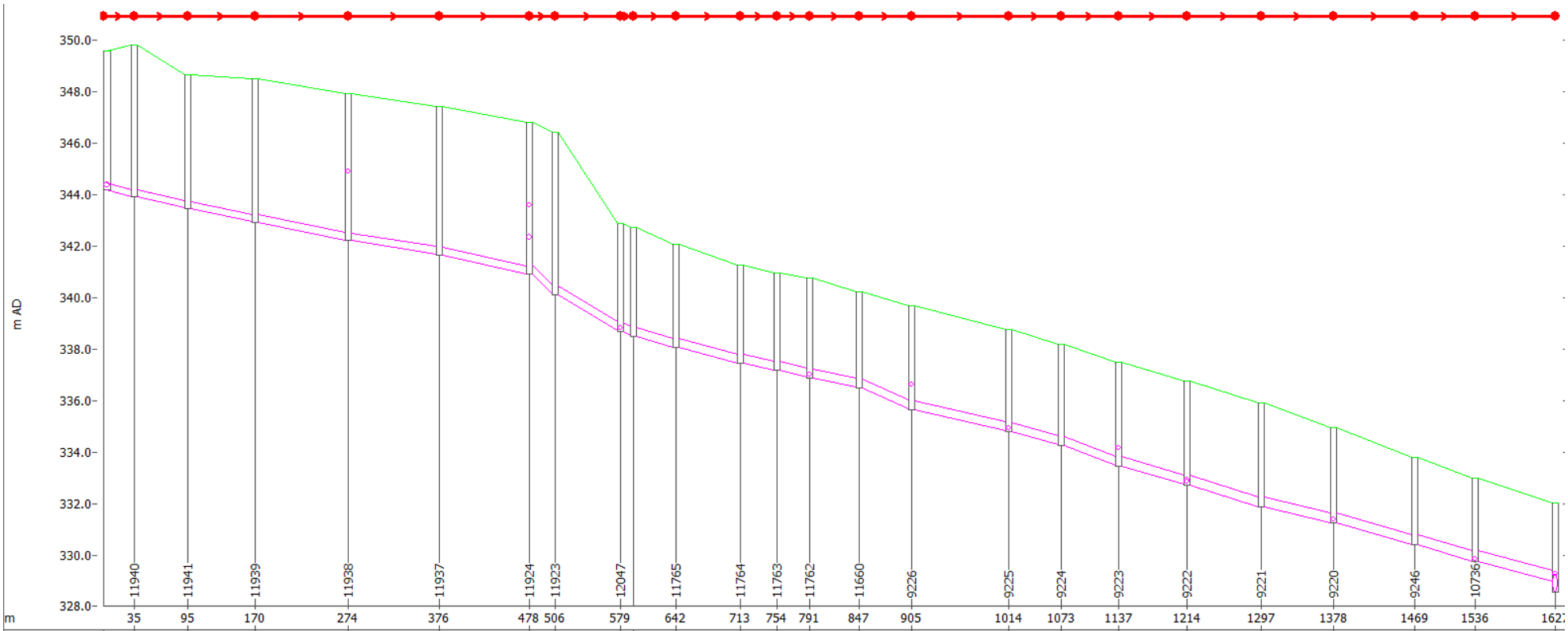

m	35	95	170	274	376	478	506	579	642	713	754	791	847	905	1014	1073	1137	1214	1297	1378	1469	1536	1627

Link	-	11940.1	11941.1	11939.1	11938.1	11937.1	-	11923.1	-	-	11765.1	-	-	11762.1	11660.1	9226.1	9225.1	9224.1	9223.1	9222.1	9221.1	9220.1	9246.1	10736.1
length (m)	35.4	59.4	75.1	104.5	102.1	101.4	28.5	72.8	-	47.9	71.6	41.2	36.5	56.1	58.2	108.9	58.8	64.3	76.4	83.5	81.1	91.2	67.1	90.2
width (mm)	250	250	300	300	300	300	350	350	-	350	350	350	350	350	350	350	350	350	350	400	400	400	400	400
us inv (m AD)	-	343.935	343.455	342.920	342.220	341.670	-	340.110	-	-	338.060	-	-	336.880	336.490	335.650	334.790	334.260	333.470	332.710	331.860	331.250	330.400	329.760
ds inv (m AD)	-	343.515	342.950	342.250	341.700	340.940	-	338.730	-	-	337.470	-	-	336.520	335.680	334.820	334.290	333.500	332.760	331.860	331.250	330.400	329.760	329.000
grad (m/m)	-	0.00707	0.00672	0.00641	0.00509	0.00720	-	0.01896	-	-	0.00823	-	-	0.00641	0.01392	0.00762	0.00851	0.01182	0.00930	0.01018	0.00752	0.00932	0.00954	0.00843
pfc (m3/s)	-	0.050	0.079	0.077	0.069	0.082	-	0.201	-	0.137	0.132	0.111	0.123	0.117	0.172	0.127	0.135	0.159	0.141	0.210	0.181	0.201	0.203	0.191
User Text 3	-	Active	Active	Active	Active	Active	-	Active	-	Active	Active	Active	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active

Node	11940	11941	11939	11938	11937	11924	11923	-	-	11765	11764	-	11762	11660	9226	9225	9224	9223	9222	9221	9220	9246	10736	-
ground (m AD)	-	348.688	348.500	347.930	347.450	346.810	-	-	-	342.084	-	-	-	-	339.678	338.761	338.195	337.500	336.761	335.917	334.952	333.814	332.999	-
User Text 2	Active	Active	Active	Active	Active	Active	Active	-	-	Active	Active	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	-

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Figure No. 1

Title **Keats Trunk – Profile 2**

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Figure No. 1

Title **Laurel Trunk Geoplan Overview**

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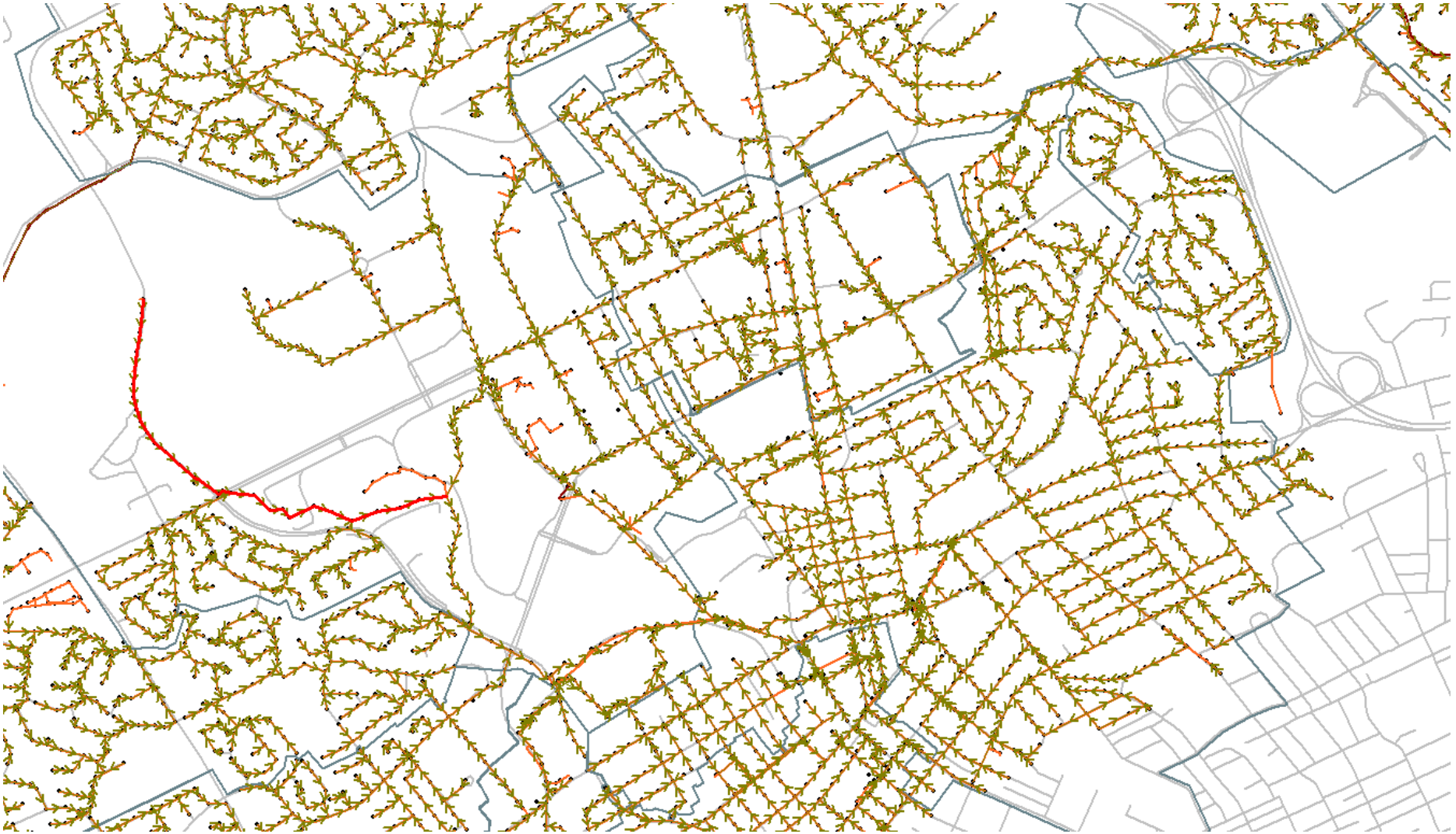

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Figure No. 1

Title **Laurel Trunk – Profile 1 Overview**

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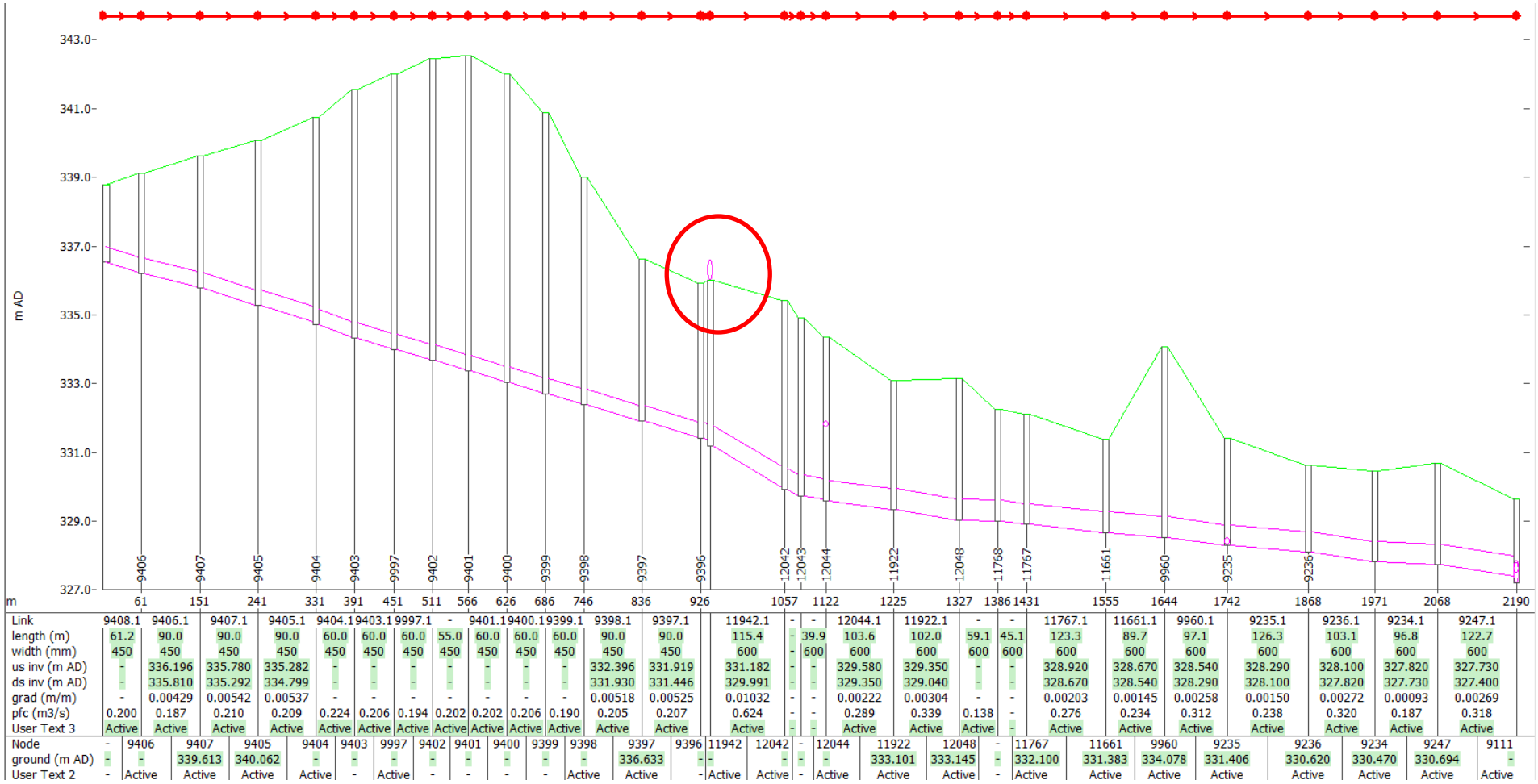
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9407
9405
9404
9403
9997
9402
9401
9400
9399
9398
9397
9396
12042
12043
12044
11922
12048
11768
11767
11661
9960
9235
9236
m
61
151
241
331
391
451
511
566
626
686
746
836
926
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1122
1225
1327
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1742
1868
1971
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2190

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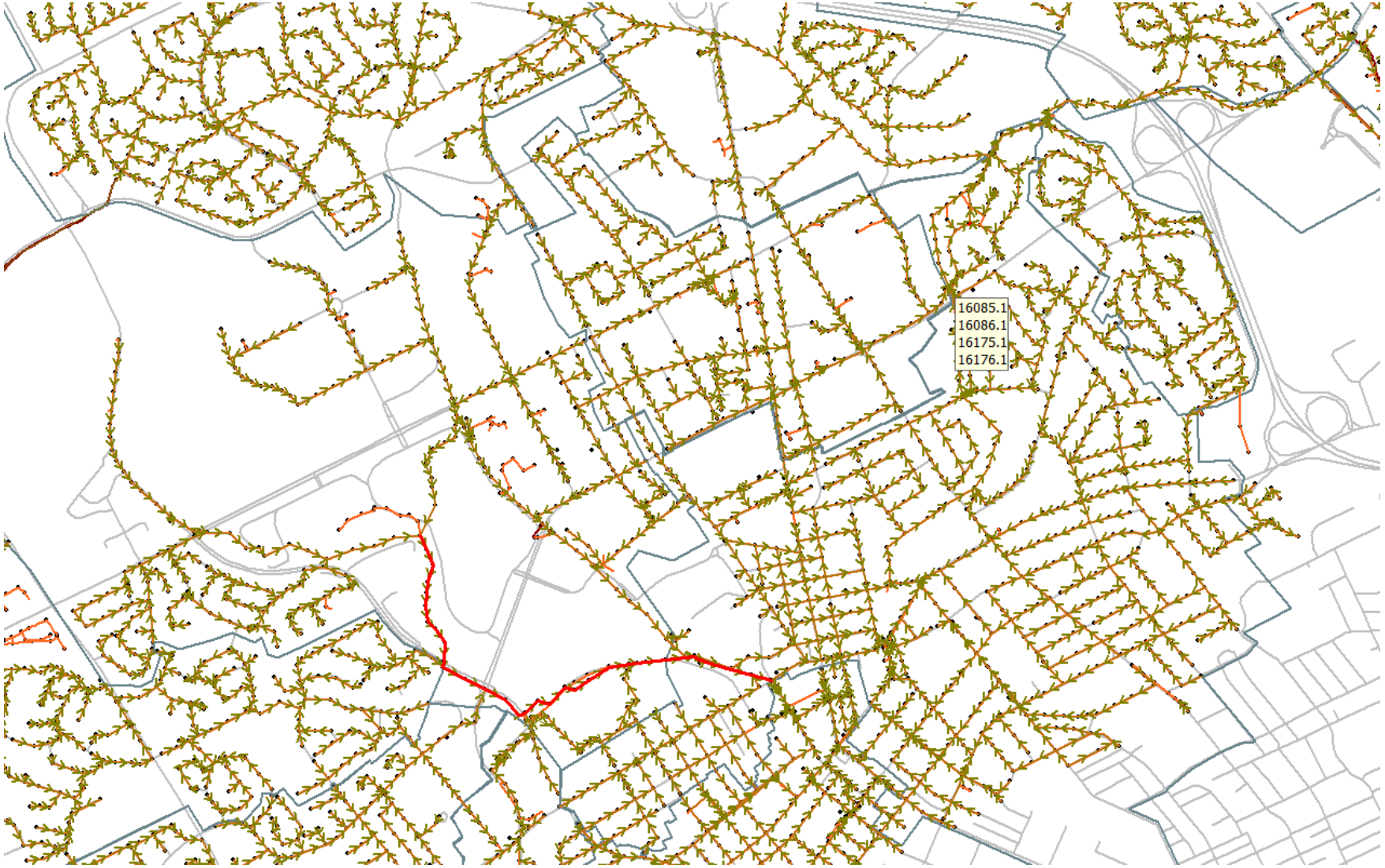

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Figure No. 1

Title **Laurel Trunk – Profile 2 Overview**

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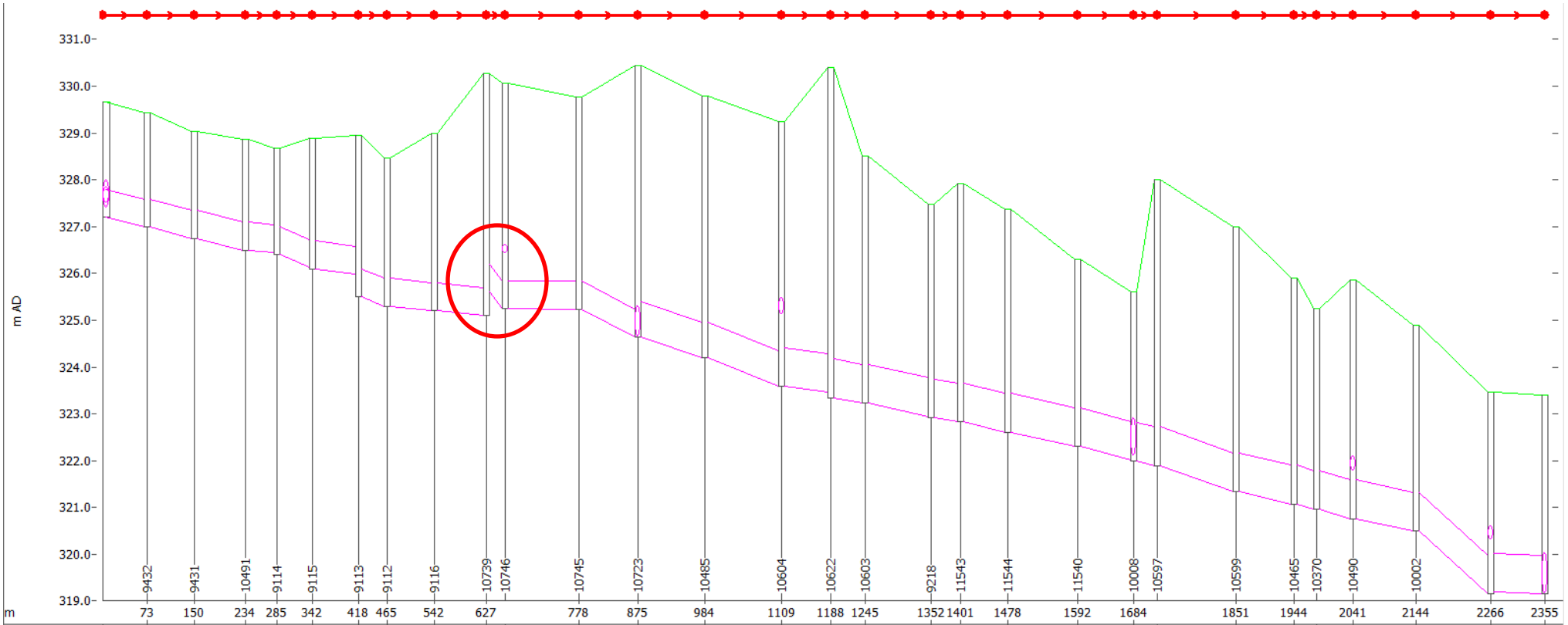
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319.0
m AD
9432
9431
10491
9114
9115
9113
9112
9116
10739
10746
10745
10723
10485
10604
10622
10603
9218
11543
11544
11540
10008
10597
10599
10465
10370
10490
10002
m
73
150
234
285
342
418
465
542
627
778
875
984
1109
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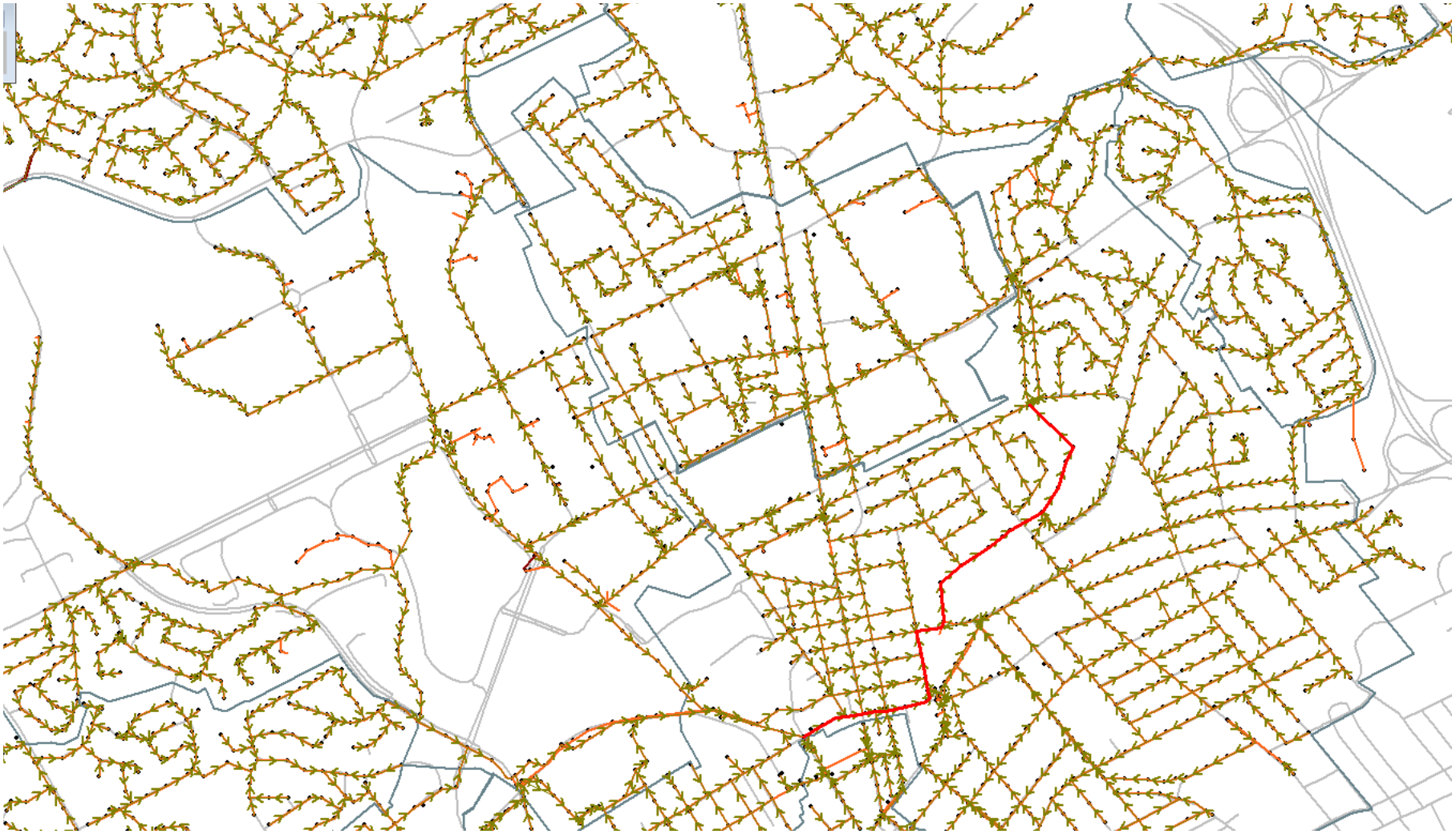

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Figure No. 1

Title **Laurel Trunk – Profile 3 Overview**

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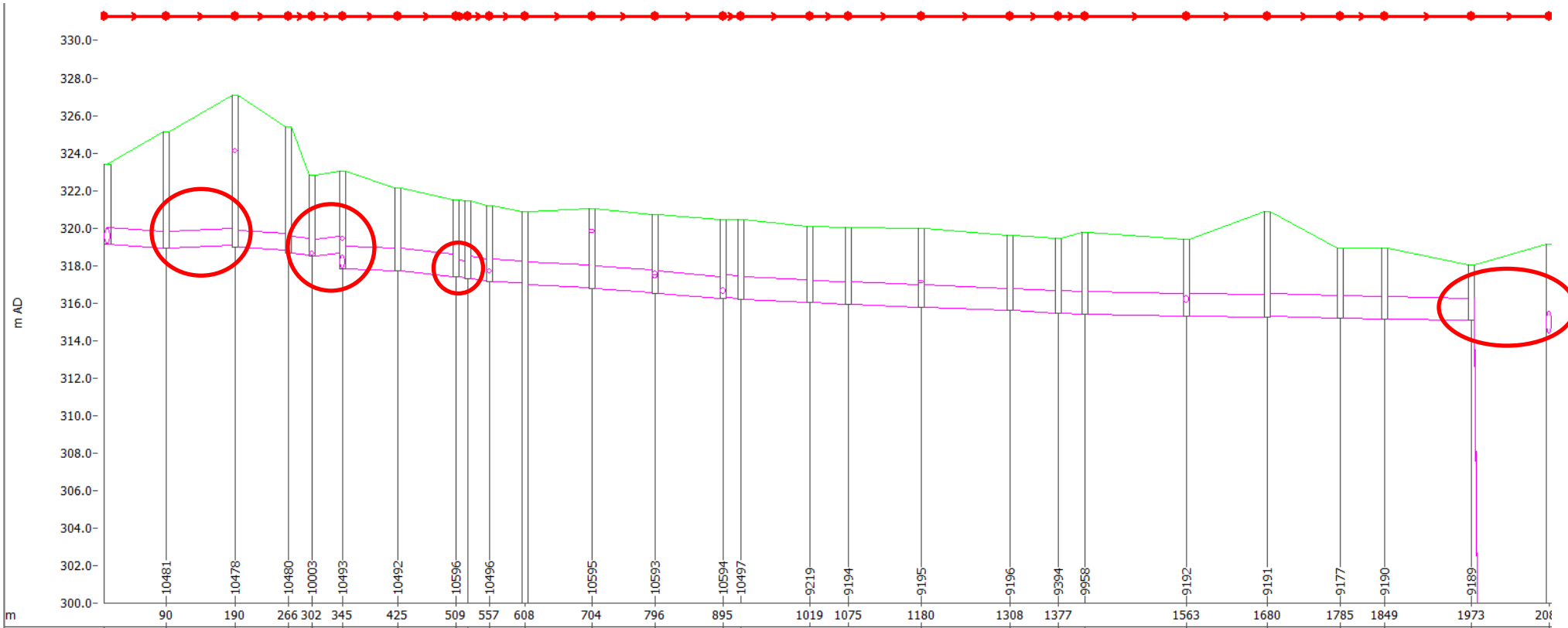

Link	10479.1	10481.1	10478.1	-	-	10493.1	10492.1	-	-	15823.1	10595.1	10593.1	-	10497.1	9219.1	9194.1	9195.1	9196.1	-	9958.1	9192.1	9191.1	9177.1	9190.1	9189.1
length (m)	89.7	100.8	75.7	-	43.1	80.5	83.4	-	50.9	96.3	91.4	98.9	-	98.7	56.1	104.8	128.6	69.0	39.3	145.9	117.0	105.3	63.9	124.2	113.1
width (mm)	900	900	900	900	900	1200	1200	-	1200	1200	1200	1200	-	1200	1200	1200	1200	1200	-	1200	1200	1200	1200	1200	1200
us inv (m AD)	319.150	318.920	318.990	-	-	317.840	317.739	-	-	317.007	316.790	316.507	-	316.212	-	315.940	315.790	315.610	-	315.430	315.320	315.313	-	315.178	315.079
ds inv (m AD)	318.920	319.110	318.820	-	-	317.739	317.425	-	-	316.824	316.580	316.236	-	316.040	-	315.780	315.610	315.460	-	315.320	315.260	315.229	-	315.079	0.000
grad (m/m)	0.00257	-0.00189	0.00225	-	-	0.00125	0.00376	-	-	0.00190	0.00230	0.00274	-	0.00174	-	0.00153	0.00140	0.00217	-	0.00075	0.00051	0.00080	-	0.00080	2.78538
pfc (m3/s)	0.917	-0.786	0.858	-	-	1.381	2.392	-	1.546	1.700	1.870	2.042	-	1.628	1.472	1.524	1.459	1.818	-	1.071	0.883	1.101	1.102	1.101	65.077
User Text 3	Active	Active	Active	-	-	Active	Active	-	Active	Active	Active	Active	-	Active	Active	Active	Active	Active	-	Active	Active	Active	Active	Active	Active

Node	-	10481	10478	-	-	10493	10492	-	-	15823	10595	10593	10594	10497	9219	9194	9195	9196	9394	9958	9192	9191	9177	9190	9189	-
ground (m AD)	-	325.139	327.070	-	-	-	322.166	-	-	-	321.020	320.720	-	-	320.090	320.050	320.000	319.600	-	319.800	319.407	320.888	318.943	318.943	318.052	-
User Text 2	-	Active	Active	-	-	Active	Active	-	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	-	Active	Active	Active	Active	Active	Active	-

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Figure No. 1

Title **Laurel Trunk Profile 3**

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Waterloo Sanitary Servicing Master Plan

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Figure No. 1

Title **Laurel Trunk – Profile 4 Overview**

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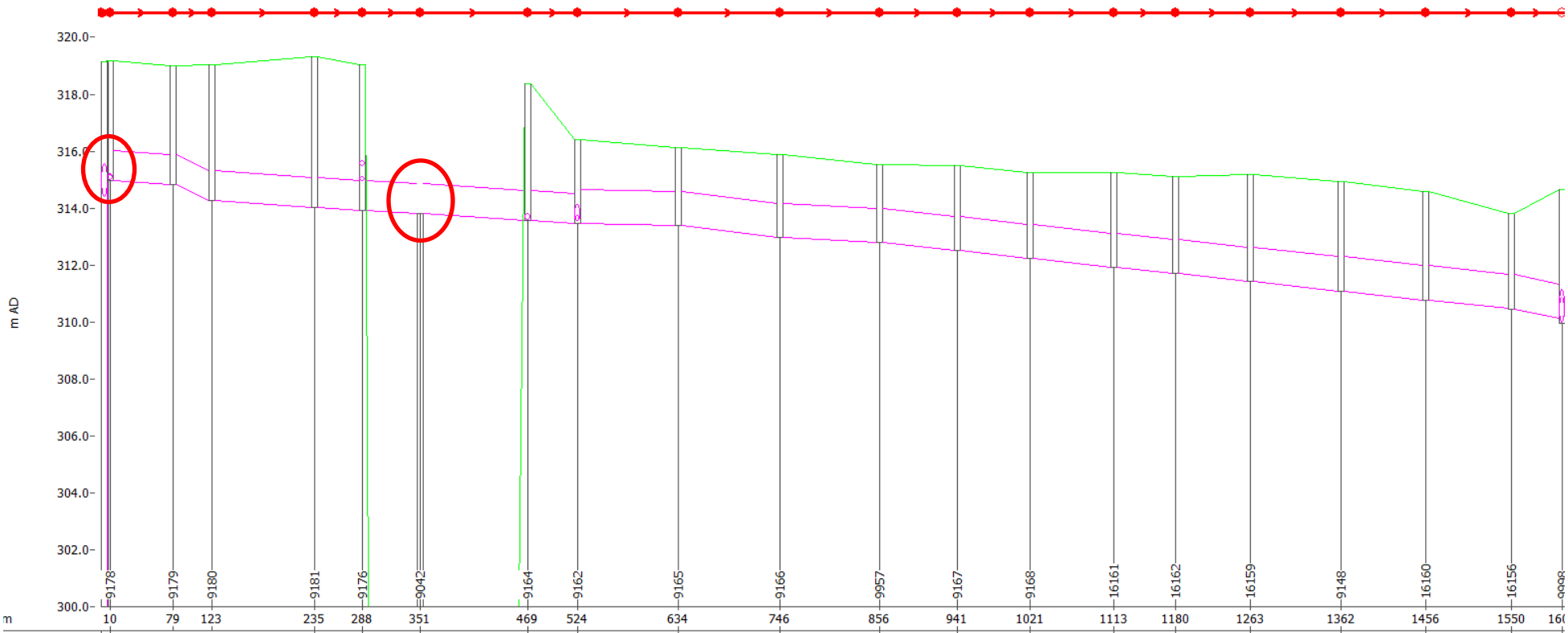

m	10	79	123	235	288	351	469	524	634	746	856	941	1021	1113	1180	1263	1362	1456	1550	160

Link	9178.1	9179.1	9180.1	9181.1	9176.1	9042.1	9164.1	9162.1	9165.1	9166.1	9957.1	9167.1	9168.1	16161.1	16162.1	16159.1	9148.1	16160.1	16156.1
length (m)	69.0	43.3	112.7	52.3	63.7	117.7	55.3	110.2	111.3	110.3	84.8	80.1	92.4	67.1	82.5	99.5	93.4	94.2	55.2
width (mm)	1050	1050	1050	1050	1050	1050	1050	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200
us inv (m AD)	314.980	-	314.270	314.040	313.937	313.810	313.580	313.460	313.400	312.970	312.792	312.509	312.241	311.932	311.708	311.433	311.100	310.788	310.470
ds inv (m AD)	314.835	-	314.040	313.937	313.810	313.580	313.460	313.400	312.970	312.792	312.509	312.241	311.932	311.708	311.433	311.100	310.788	310.474	310.130
grad (m/m)	0.00210	-	0.00204	0.00197	0.00199	0.00195	0.00217	0.00054	0.00386	0.00161	0.00334	0.00335	0.00334	0.00334	0.00333	0.00335	0.00334	0.00333	0.00616
pfc (m3/s)	1.252	3.118	1.234	1.212	1.219	1.207	1.272	0.910	2.424	1.566	2.253	2.256	2.255	2.252	2.251	2.256	2.254	2.251	3.061
User Text 3	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active

Node	9178	9179	9180	9181	9176	9042	9164	9162	9165	9166	9957	9167	9168	16161	16162	16159	9148	16160	16156	-
ground (m AD)	-	-	319.025	319.305	319.028	0.000	318.369	316.400	316.140	315.880	315.551	315.506	315.262	315.247	315.126	315.180	314.925	314.600	313.810	-
User Text 2	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	-

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Figure No. 1

Title **Laurel Trunk Profile 4**

Client/Project City of Waterloo

Waterloo Sanitary Servicing Master Plan

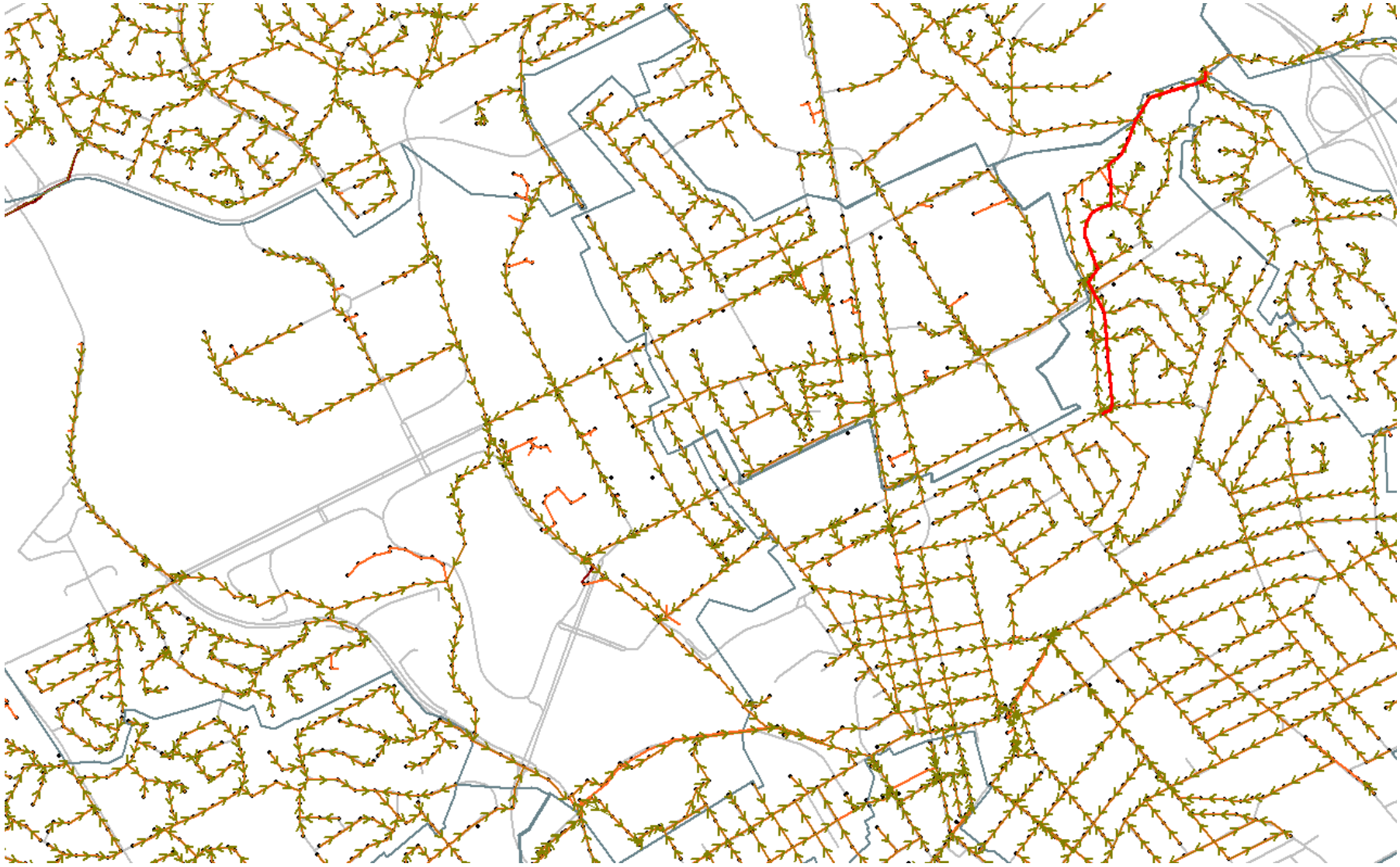

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Figure No. 1

Title **Laurel Trunk – Profile 5 Overview**

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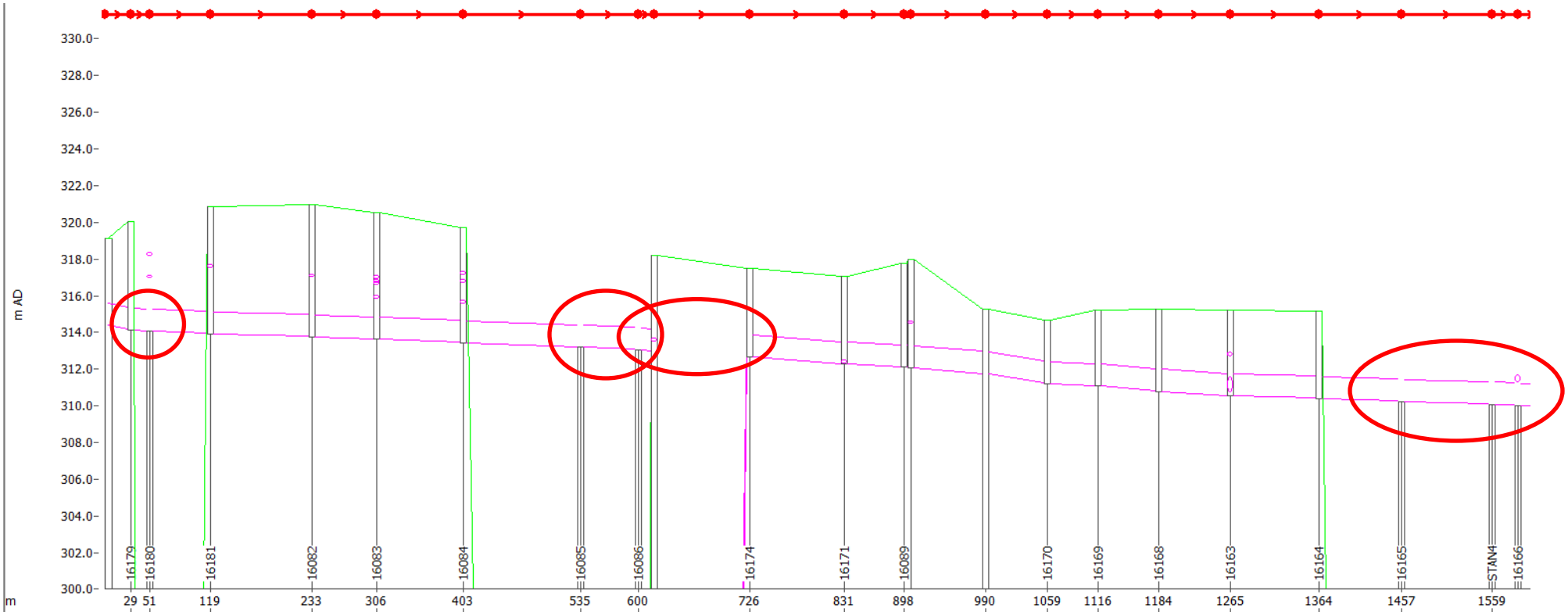

m	29	51	119	233	306	403	535	600	726	831	898	990	1059	1116	1184	1265	1364	1457	1559

Link	-	-	16180.1	16181.1	16082.1	16083.1	16084.1	16085.1	-	16175.1	16174.1	16171.1	16173.1	16172.1	16170.1	16169.1	16168.1	16163.1	16164.1	16165.1	-
length (m)	29.4	-	67.7	114.8	72.1	97.3	132.4	64.7	-	108.0	105.7	67.2	83.4	69.1	57.0	67.8	80.9	99.6	92.4	102.7	28.8
width (mm)	-	-	1200	1200	1200	1200	1200	1200	-	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	-
us inv (m AD)	-	-	314.065	313.922	313.750	313.617	313.434	313.190	-	0.000	312.684	312.266	312.050	311.740	311.213	311.080	310.795	310.525	310.392	310.228	-
ds inv (m AD)	-	-	313.952	313.780	313.647	313.464	313.220	313.076	-	312.714	312.269	312.135	311.770	311.243	311.110	310.825	310.555	310.422	310.258	310.115	-
grad (m/m)	-	-	0.00167	0.00124	0.00143	0.00157	0.00162	0.00176	-	-2.89672	0.00393	0.00195	0.00336	0.00719	0.00181	0.00376	0.00297	0.00103	0.00145	0.00110	-
pfc (m3/s)	-	-	1.593	1.372	1.473	1.546	1.567	1.637	-	-66.365	2.444	1.722	2.260	3.306	1.657	2.392	2.124	1.254	1.485	1.294	-
User Text 3	-	-	Active	Active	Active	Active	Active	Active	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	-

Node	-	-	16181	16082	16083	16084	16085	-	16175	16174	16171	-	-	16172	16170	16169	16168	16163	16164	16165	STAN4	-
ground (m AD)	-	0.000	320.864	320.970	320.550	319.700	0.000	-	318.203	317.485	317.046	-	-	315.252	314.696	315.200	315.250	315.216	315.145	0.000	0.000	-
User Text 2	-	-	Active	Active	Active	Active	Active	-	Active	Active	Active	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	-

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Figure No. 1

Title **Laurel Trunk Profile 5**

Client/Project City of Waterloo

Waterloo Sanitary Servicing Master Plan

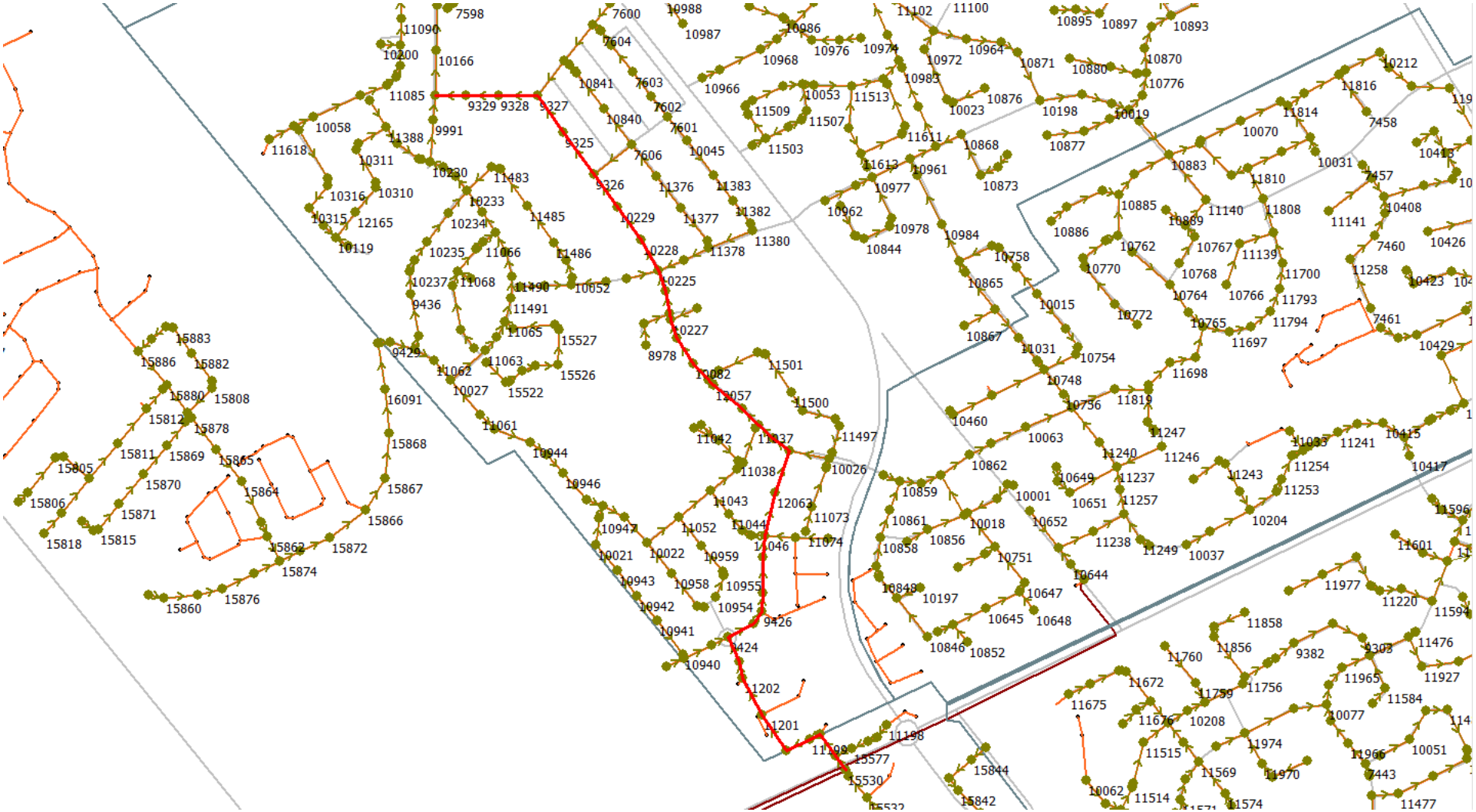

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Figure No. 1

Title **Leachate Trunk Geoplan Overview**

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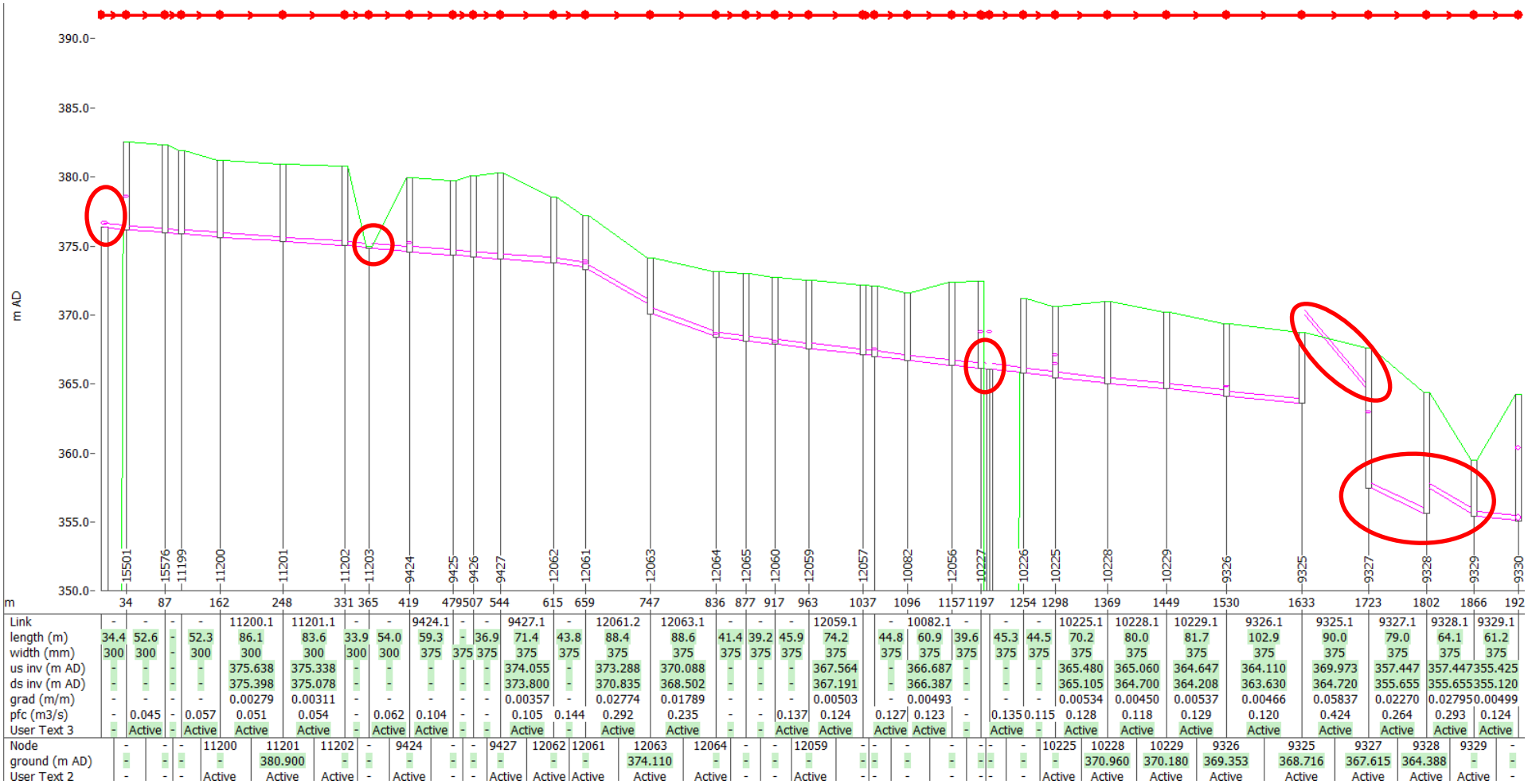

m	34	87	162	248	331	365	419	479	507	544	615	659	747	836	877	917	963	1037	1096	1157	1197	1254	1298	1369	1449	1530	1633	1723	1802	1866	192
Link	-	-	-	11200.1	11201.1	-	-	9424.1	-	-	9427.1	-	12061.2	12063.1	-	-	-	12059.1	-	10082.1	-	-	-	10225.1	10228.1	10229.1	9326.1	9325.1	9327.1	9328.1	9329.1
length (m)	34.4	52.6	- 52.3	86.1	83.6	33.9	54.0	59.3	-	36.9	71.4	43.8	88.4	88.6	41.4	39.2	45.9	74.2	44.8	60.9	39.6	45.3	44.5	70.2	80.0	81.7	102.9	90.0	79.0	64.1	61.2
width (mm)	300	300	- 300	300	300	300	300	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375
us inv (m AD)	-	-	- -	375.638	375.338	-	-	-	-	-	374.055	-	373.288	370.088	-	-	-	367.564	-	366.687	-	-	-	365.480	365.060	364.647	364.110	369.973	357.447	357.447	355.425
ds inv (m AD)	-	-	- -	375.398	375.078	-	-	-	-	-	373.800	-	370.835	368.502	-	-	-	367.191	-	366.387	-	-	-	365.105	364.700	364.208	363.630	364.720	355.655	355.655	355.120
grad (m/m)	-	-	- -	0.00279	0.00311	-	-	-	-	-	0.00357	-	0.02774	0.01789	-	-	-	0.00503	-	0.00493	-	-	-	0.00534	0.00450	0.00537	0.00466	0.05837	0.02270	0.02795	0.00499
pfc (m3/s)	-	0.045	- 0.057	0.051	0.054	-	0.062	0.104	-	-	0.105	0.144	0.292	0.235	-	-	0.137	0.124	0.127	0.123	-	0.135	0.115	0.128	0.118	0.129	0.120	0.424	0.264	0.293	0.124
User Text 3	-	Active	- Active	Active	Active	-	Active	Active	-	-	Active	-	Active	Active	-	-	Active	Active	Active	Active	-	Active	-	Active	Active	Active	Active	Active	Active	Active	Active
Node	-	-	- 11200	11201	11202	-	9424	-	-	9427	12062	12061	12063	12064	-	-	12059	-	-	-	-	-	-	10225	10228	10229	9326	9325	9327	9328	9329	-
ground (m AD)	-	-	- -	380.900	-	-	-	-	-	-	-	-	374.110	-	-	-	-	-	-	-	-	-	-	370.960	370.180	369.353	368.716	367.615	364.388	-	-
User Text 2	-	-	- Active	Active	Active	-	Active	-	-	Active	Active	Active	Active	Active	-	-	Active	-	-	-	-	-	-	Active	Active	Active	Active	Active	Active	Active	Active	-

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Figure No. 1

Title **Leachate Trunk Profile**

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Waterloo Sanitary Servicing Master Plan

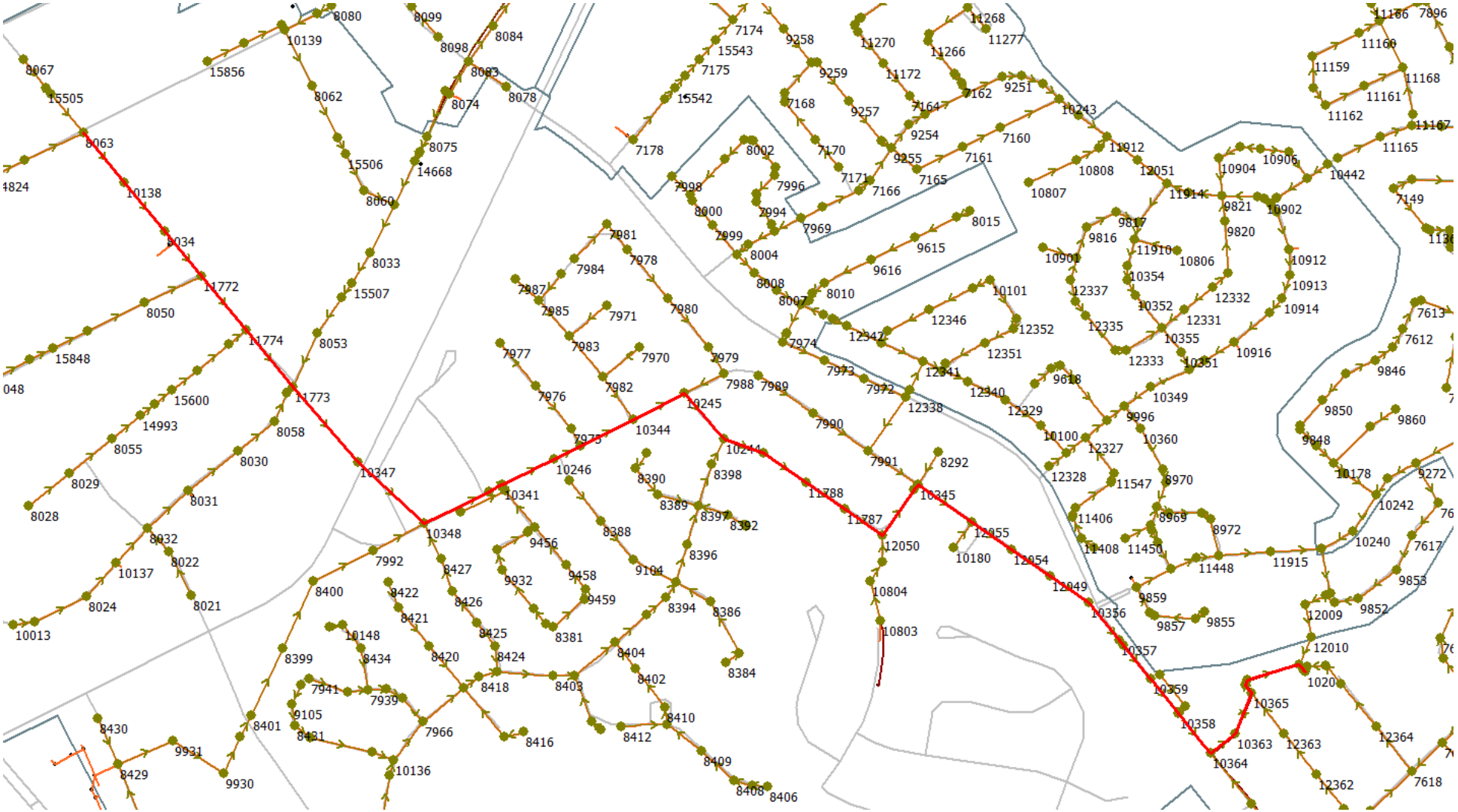

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Figure No. 1

Title **Lee/Dunvegan Trunk Geoplan Overview**

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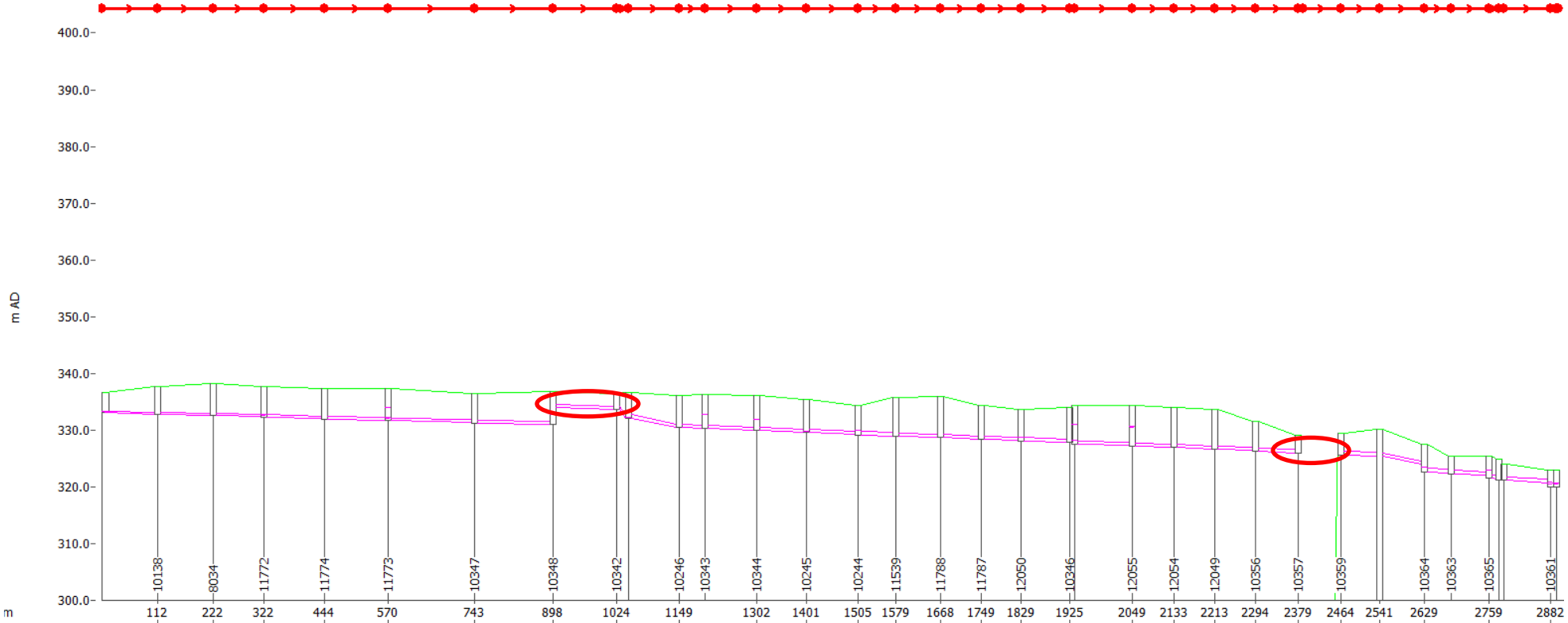

m	112	222	322	444	570	743	898	1024	1149	1302	1401	1505	1579	1668	1749	1829	1925	2049	2133	2213	2294	2379	2464	2541	2629	2759	2882
Link	8063.1	10138.1	8034.1	11772.1	11774.1	11773.1	10347.1	10348.1	10341.1	-	10343.1	10344.1	10245.1	-	-	-	-	12050.1	10345.1	-	-	-	-	-	-	-	-	10367.1
length (m)	112.0	110.4	100.0	121.7	125.8	172.6	155.5	125.8	100.2	50.4	103.0	98.8	103.9	73.6	89.5	81.1	79.7	95.4	113.2	84.2	80.0	81.1	84.9	74.7	76.4	88.6	54.2	75.9	94.7
width (mm)	300	300	300	500	500	500	500	600	600	600	600	600	600	600	600	600	600	600	525	525	525	525	600	600	600	600	600	600	600
us inv (m AD)	333.128	332.904	332.684	332.297	332.040	331.716	331.246	333.978	332.220	-	330.357	329.982	329.650	-	-	-	-	328.151	327.659	-	-	-	-	-	-	-	-	-	321.191
ds inv (m AD)	332.904	332.684	332.460	332.055	331.798	331.397	331.100	333.715	330.480	-	330.017	329.695	329.277	-	-	-	-	327.877	327.322	-	-	-	-	-	-	-	-	-	320.826
grad (m/m)	0.00200	0.00199	0.00224	0.00199	0.00192	0.00185	0.00094	0.00209	0.01737	-	0.00330	0.00291	0.00359	-	-	-	-	0.00287	0.00298	-	-	-	-	-	-	-	-	-	0.00385
pfc (m3/s)	0.043	0.043	0.046	0.168	0.166	0.162	0.116	0.281	0.809	-	0.353	0.331	0.368	0.322	0.305	0.380	0.335	0.329	0.235	0.222	0.234	0.241	0.348	0.000	0.326	0.765	-	0.370	0.381
User Text 3	Active	Active	Active	Active	Active	Active	Active	Active	Active	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active		Active	Active	-	Active	Active
Node	-	10138	8034	11772	11774	11773	10347	10348	-	-	-	-	-	10344	10245	10244	-	11788	-	12050	-	-	12055	-	-	10356	-	-	10358	-	-	-	-	-
ground (m AD)	-	337.712	338.293	337.818	337.310	337.459	336.566	336.934	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
User Text 2	-	Active	Active	Active	Active	Active	Active	Active	-	-	-	-	-	Active	Active	Active	Active	Active	-	Active	-	-	Active	Active	Active	Active	-	-	Active	-	-	-	-	-

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Figure No. 1

Title **Lee/Dunvegan Trunk Profile**

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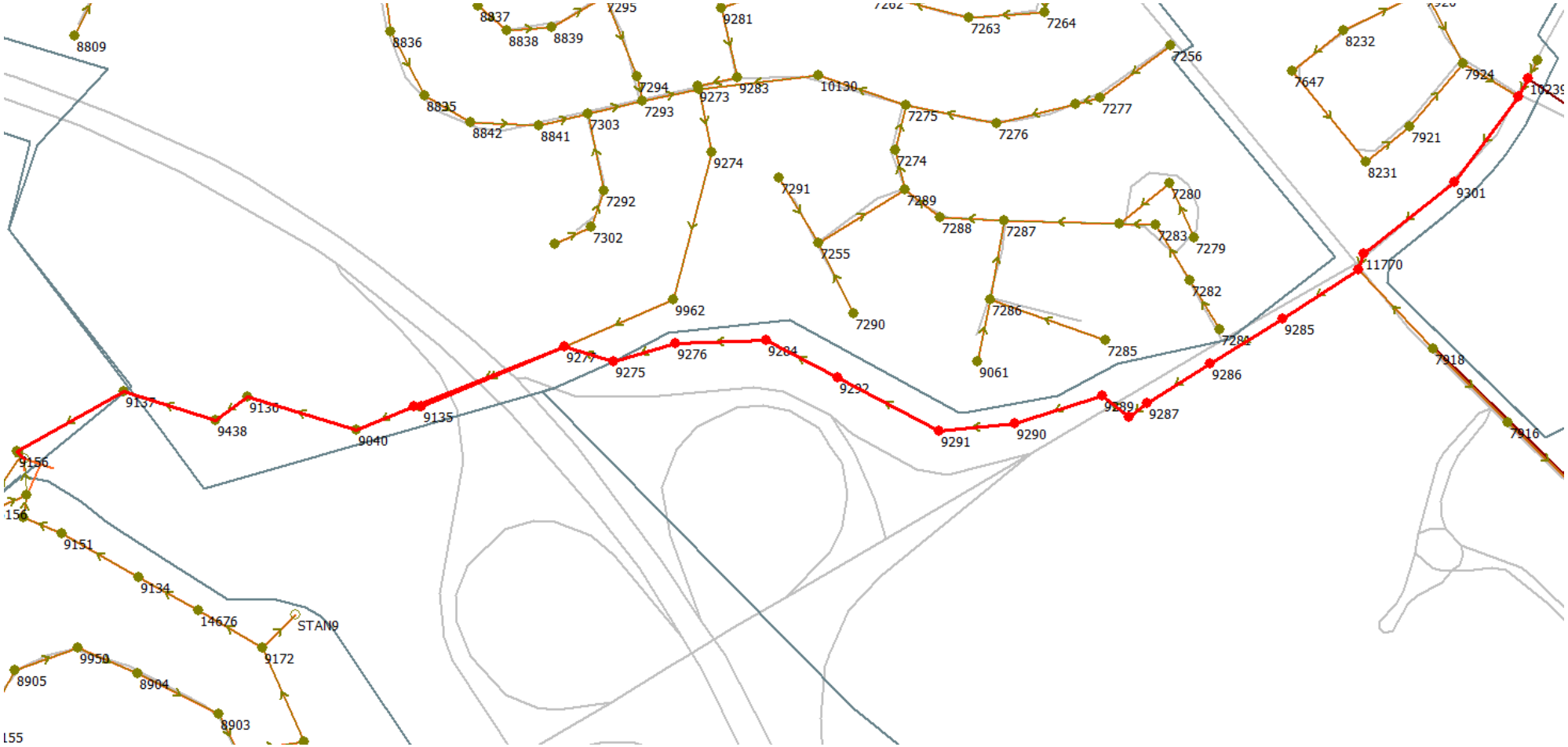

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Figure No. 1

Title **Lexington Trunk Geoplan Overview**

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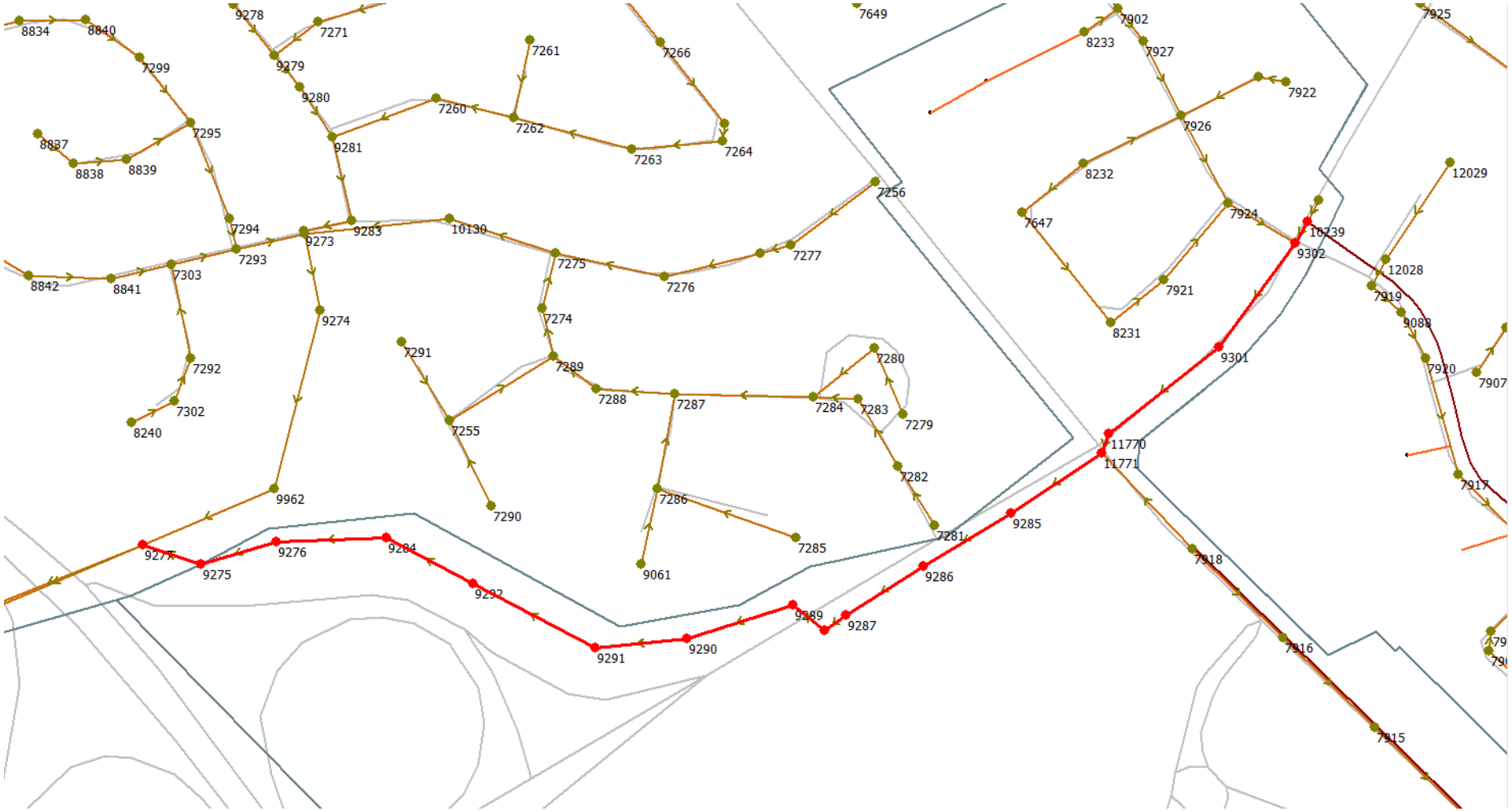

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Figure No. 1

Title **Lexington Trunk Profile 1 Overview**

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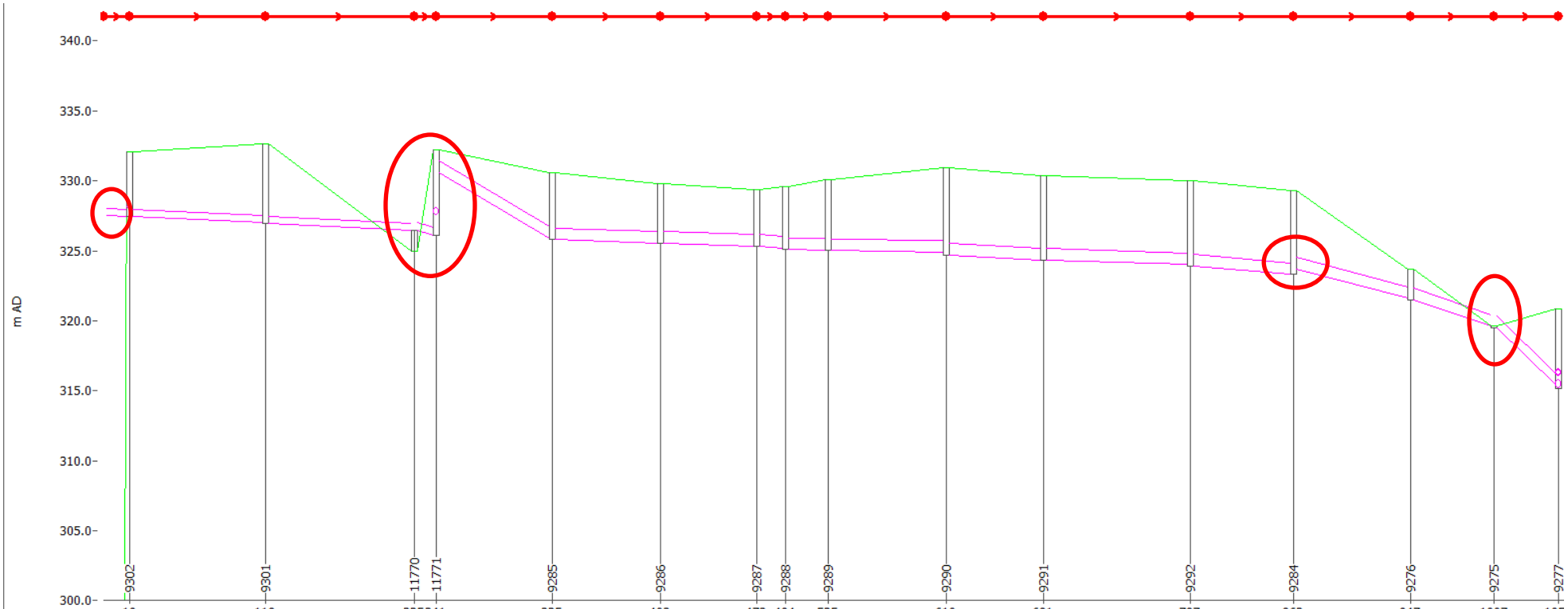

m	19	118	225	241	325	403	473	494	525	610	681	787	862	947	1007	105
Link	-	9302.1	9301.1	-	11771.1	9285.1	9286.1	-	9288.1	9289.1	9290.1	9291.1	9292.1	9284.1	9276.1	9275.1
length (m)	19.1	98.6	107.7	-	83.5	78.7	69.7	20.8	31.0	85.6	70.2	106.4	74.8	85.0	60.0	47.1
width (mm)	500	500	500	600	825	825	825	825	825	825	825	825	825	825	825	825
us inv (m AD)	-	327.490	326.990	-	330.610	325.810	325.570	-	-	325.010	324.710	324.340	323.930	323.710	321.520	319.510
ds inv (m AD)	-	327.020	326.476	-	325.930	325.570	325.350	-	-	324.920	324.360	324.020	323.320	321.600	319.610	315.430
grad (m/m)	-	0.00477	0.00477	-	0.05605	0.00305	0.00316	-	-	0.00105	0.00499	0.00301	0.00816	0.02482	0.03186	0.08661
pfc (m3/s)	-	0.261	0.261	-	3.399	0.793	0.807	-	0.516	0.466	1.014	0.787	1.297	2.262	2.563	4.225
User Text 3	-	Active	Active	-	Active	Active	Active	-	Active	Active	Active	Active	Active	Active	Active	Active
Node	9302	9301	11770	11771	9285	9286	9287	9288	9289	9290	9291	9292	9284	9276	9275	-
ground (m AD)	332.074	332.637	325.000	332.232	330.612	329.811	329.355	-	330.063	330.929	330.367	330.020	329.329	323.716	319.615	-
User Text 2	Active	Active	Active	Active	Active	Active	Active	-	Active	Active	Active	Active	Active	Active	Active	-

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Figure No. 1

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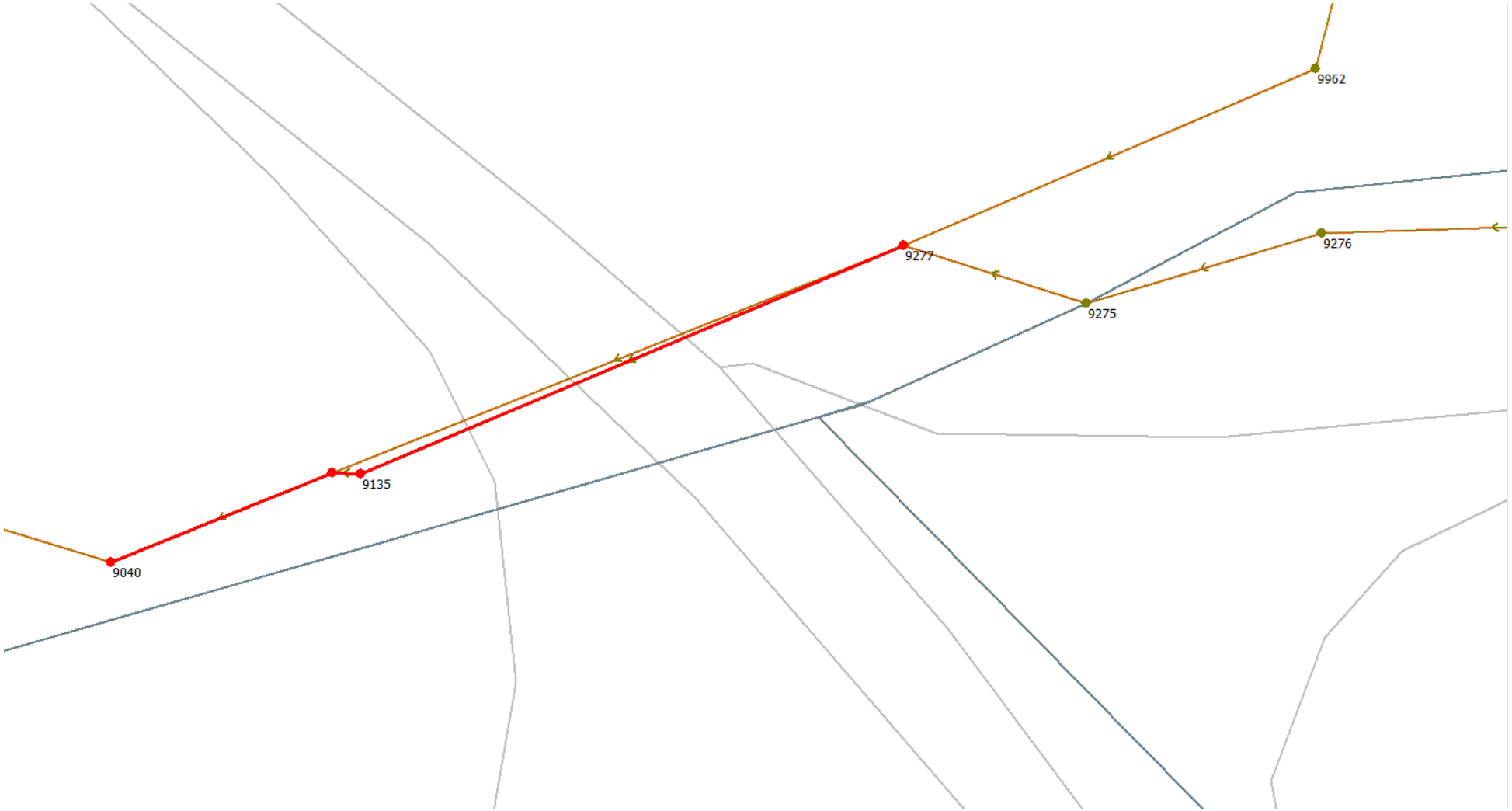

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Figure No. 1

Title **Lexington Trunk Profile 2 Overview**

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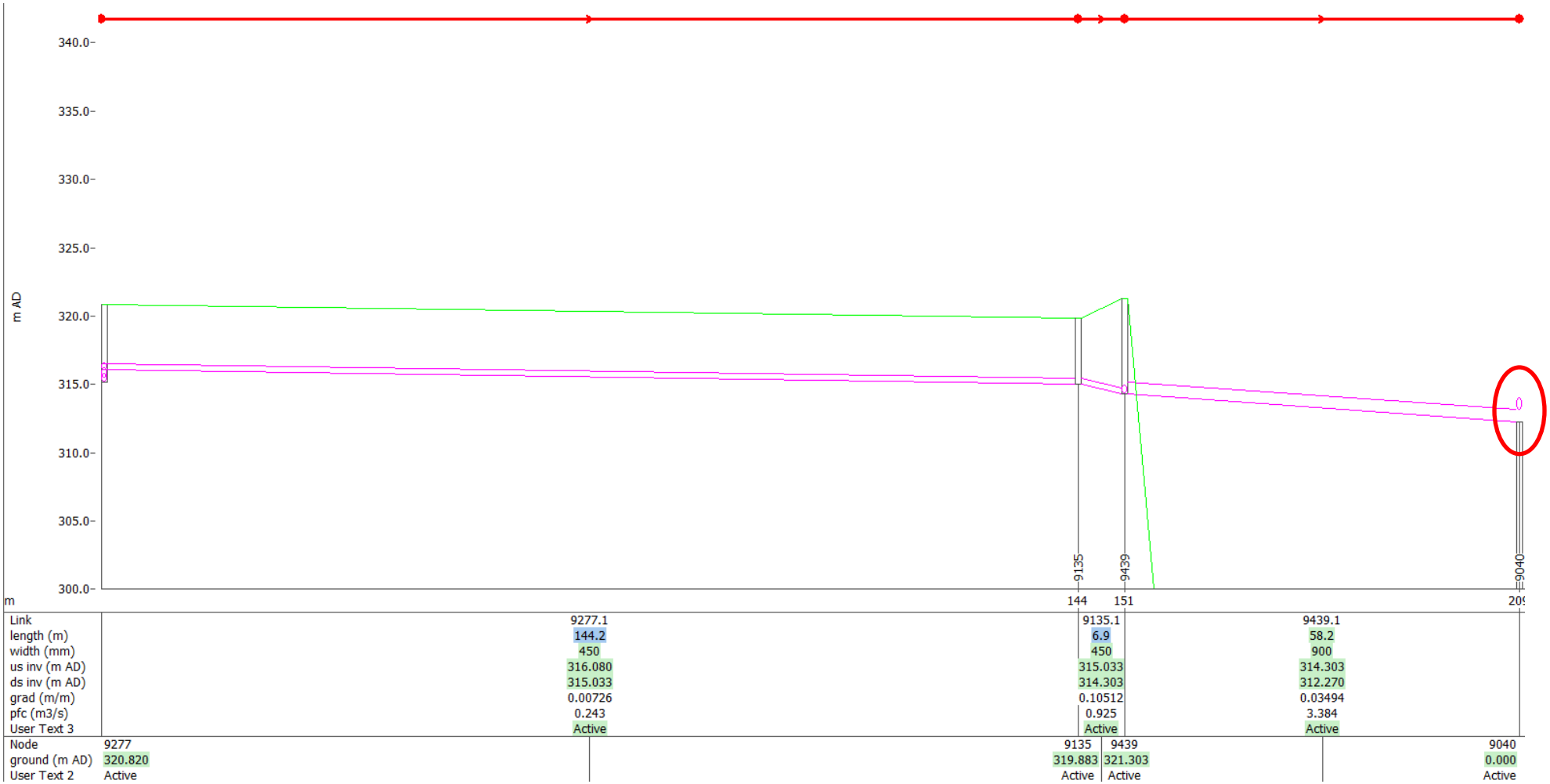

Link		9277.1	9135.1	9439.1	
length (m)		144.2	6.9	58.2	
width (mm)		450	450	900	
us inv (m AD)		316.080	315.033	314.303	
ds inv (m AD)		315.033	314.303	312.270	
grad (m/m)		0.00726	0.10512	0.03494	
pfc (m3/s)		0.243	0.925	3.384	
User Text 3		Active	Active	Active	
Node	9277		9135	9439	9040
ground (m AD)	320.820		319.883	321.303	0.000
User Text 2	Active		Active	Active	Active

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Figure No. 1

Title **Lexington Trunk Profile 2**

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Waterloo Sanitary Servicing Master Plan

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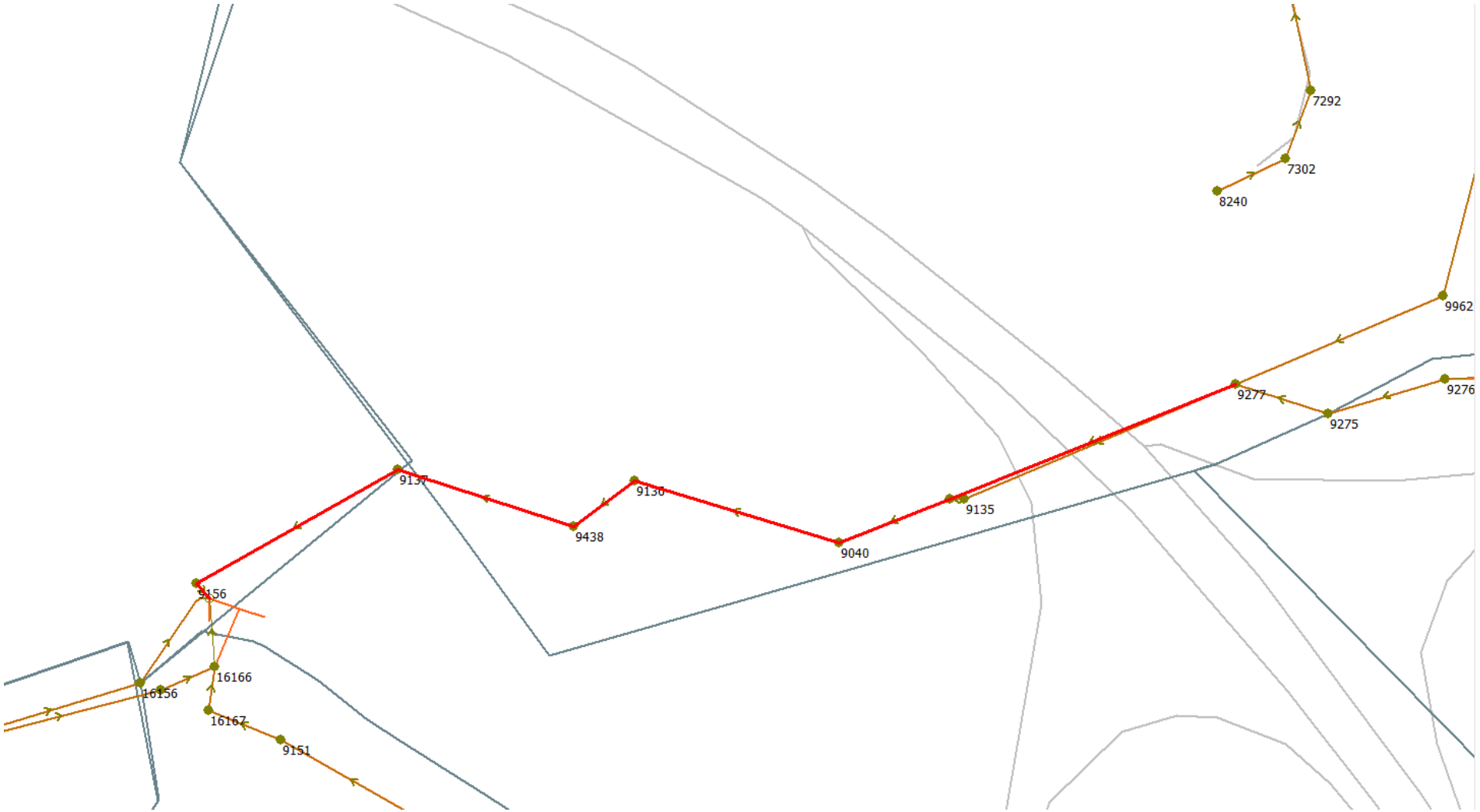

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Figure No. 1

Title **Lexington Trunk Profile 3 Overview**

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Client/Project City of Waterloo

Waterloo Sanitary Servicing Master Plan

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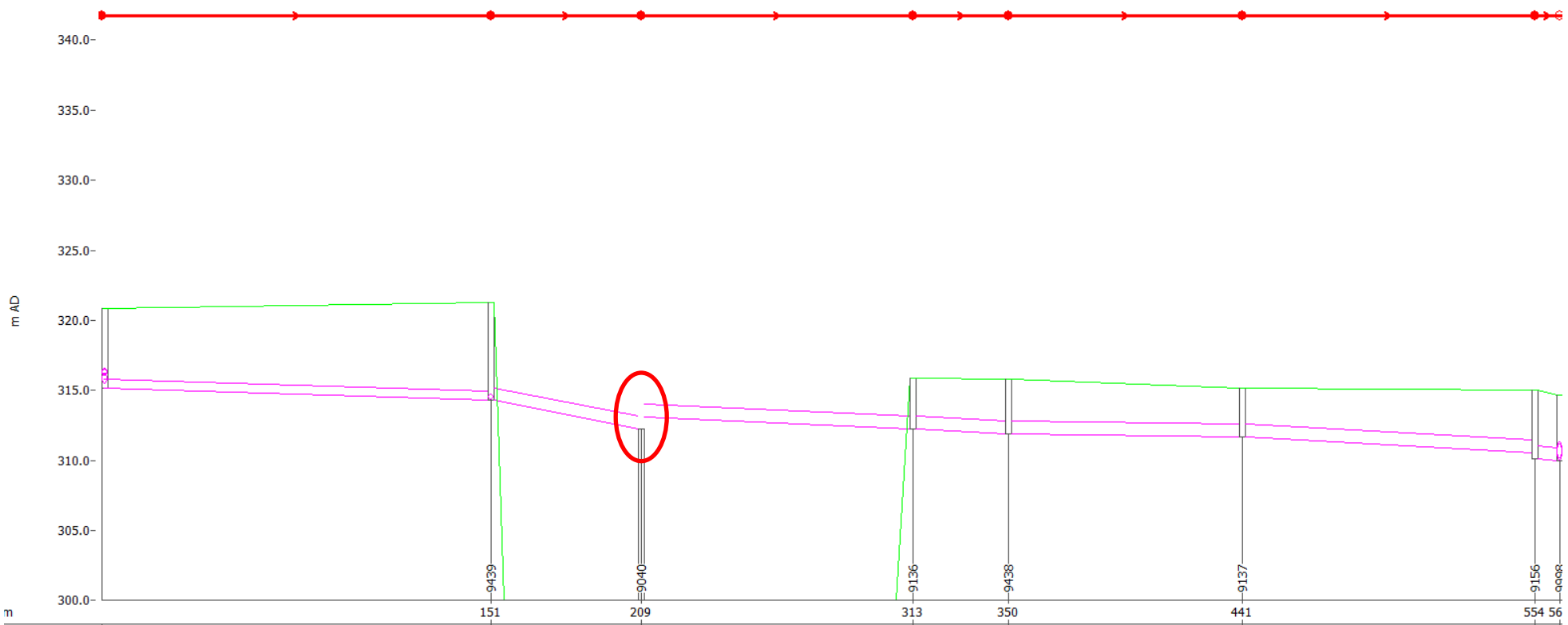

Link	9277.2	9439.1	9040.2	9136.1	9438.1	9137.1	-
length (m)	150.5	58.2	104.7	37.0	90.3	113.0	9.7
width (mm)	650	900	900	900	900	900	900
us inv (m AD)	315.190	314.303	313.120	312.270	311.920	311.700	-
ds inv (m AD)	314.303	312.270	312.270	311.920	311.700	310.540	-
grad (m/m)	0.00589	0.03494	0.00812	0.00945	0.00244	0.01027	-
pfc (m3/s)	0.584	3.384	1.631	1.761	0.894	1.835	-
User Text 3	Active	Active	Active	Active	Active	Active	-

Node	9277	9439	9040	9136	9438	9137	9156
ground (m AD)	320.820	321.303	0.000	315.860	315.820	315.140	315.056
User Text 2	Active	Active	Active	Active	Active	Active	Active

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Figure No. 1

Title **Lexington Trunk Profile 3**

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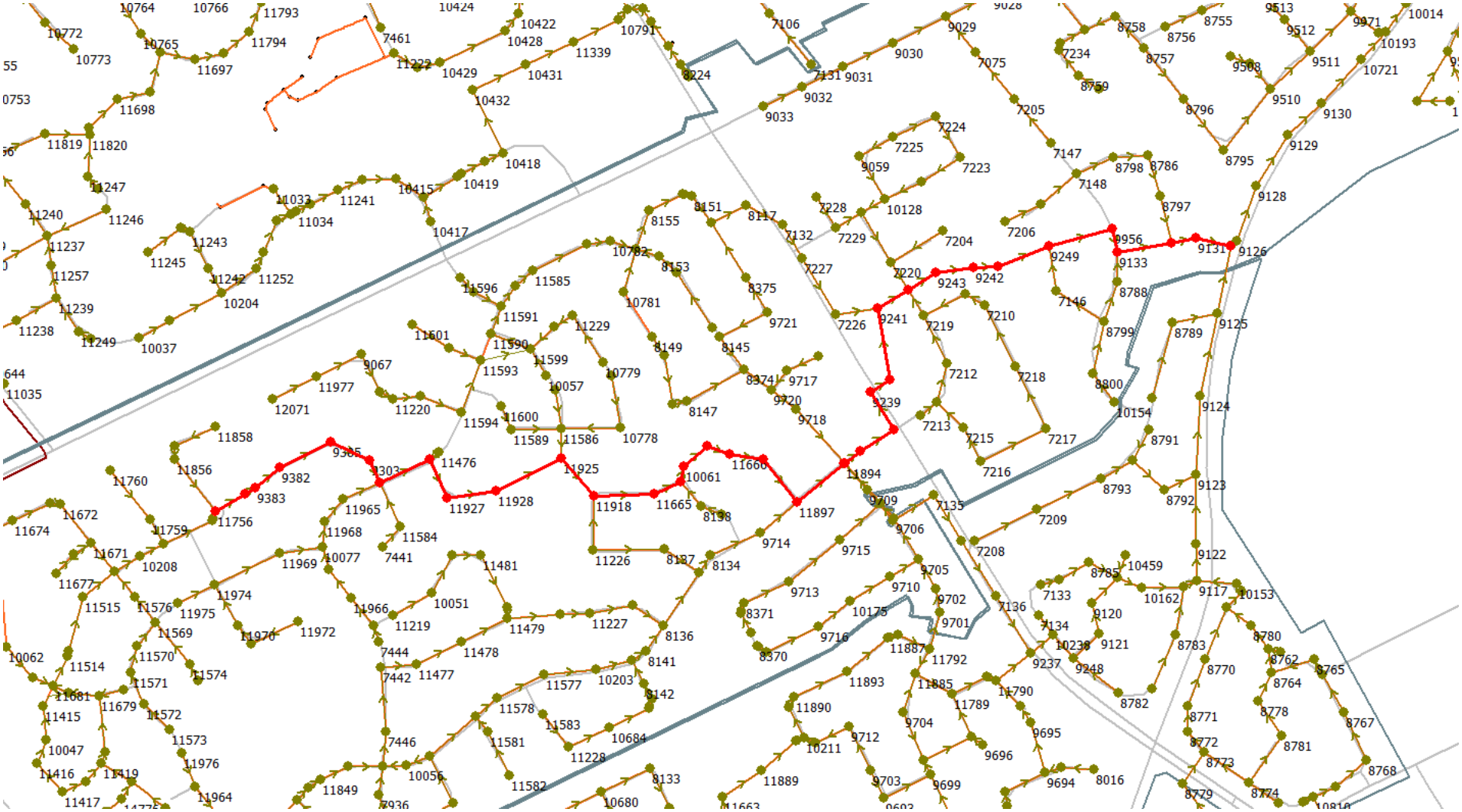

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Figure No. 1

Title **Maple Hill Trunk Geoplan Overview**

Client/Project City of Waterloo

Waterloo Sanitary Servicing Master Plan

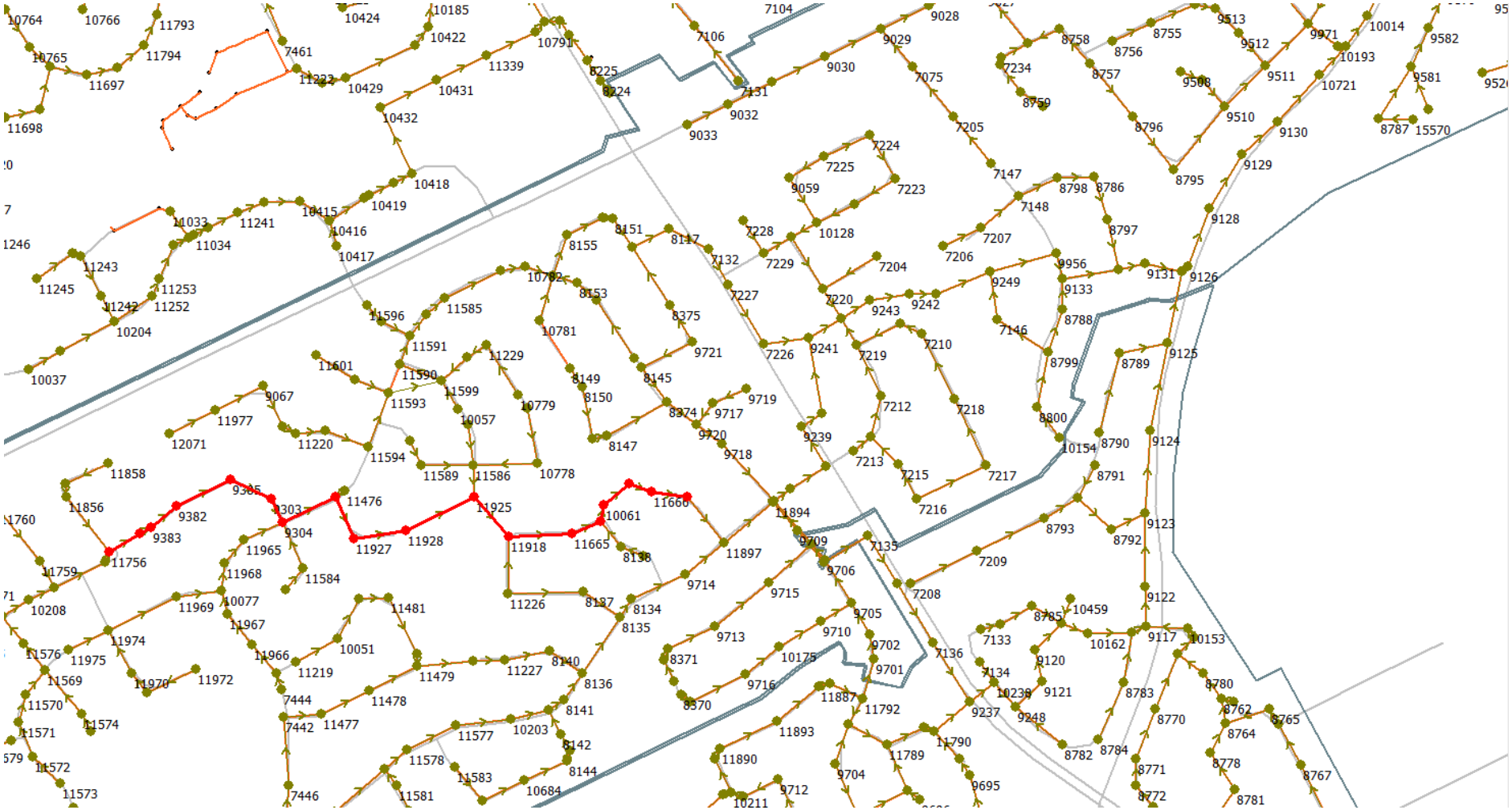

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Figure No. 1

Title **Maple Hill Trunk Profile 1 Overview**

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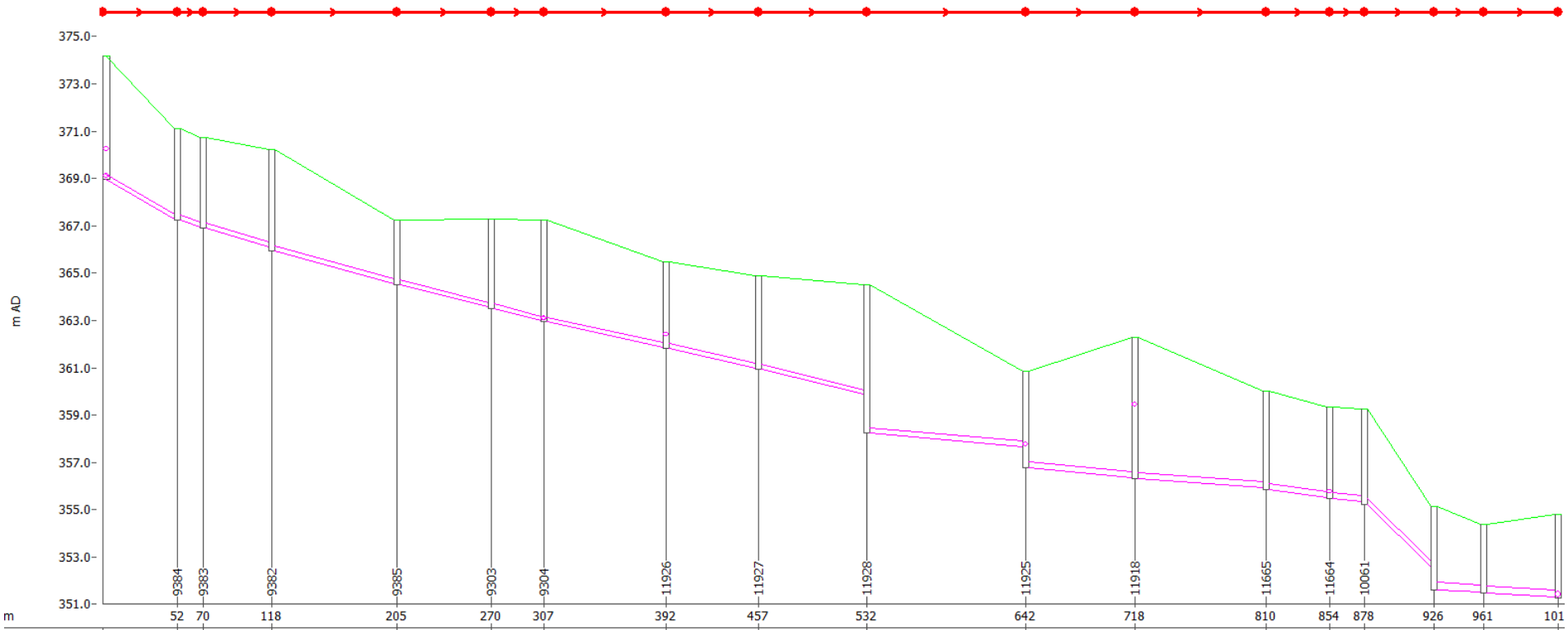

Link	11756.1	-	9383.1	9382.1	9385.1	9303.1	9304.1	11926.1	11927.1	11928.1	11925.1	11918.1	11665.1	-	10061.1	11667.1	11666.1		
length (m)	52.1	18.0	47.9	86.8	65.7	36.7	84.8	64.6	75.0	110.8	76.0	91.5	44.3	24.0	48.2	34.8	52.0		
width (mm)	200	200	200	200	200	200	200	200	200	250	250	250	250	250	250	300	300		
us inv (m AD)	368.960	-	366.900	365.950	364.516	363.524	362.938	361.823	360.934	358.230	356.770	356.320	355.860	-	355.240	351.630	351.490		
ds inv (m AD)	367.280	-	366.124	364.566	363.574	362.988	361.876	360.984	359.870	357.680	356.350	355.930	355.530	-	352.580	351.510	351.315		
grad (m/m)	0.03226	-	0.01620	0.01594	0.01434	0.01460	0.01252	0.01299	0.01418	0.00496	0.00553	0.00426	0.00745	-	0.05519	0.00344	0.00337		
pfc (m3/s)	0.059	-	0.042	0.041	0.039	0.040	0.037	0.037	0.039	0.042	0.044	0.039	0.051	0.044	0.140	0.057	0.056		
User Text 3	Active	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active		
Node	-	9384	9383	9382	9385	9303	9304	11926	11927	11928	11925	11918	11665	11664	10061	11667	11666	-	
ground (m AD)	-	-	-	370.244	367.241	367.292	367.258	365.487	364.897	364.534	360.850	362.287	360.018	-	-	355.150	354.401	-	
User Text 2	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	-	

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Figure No. 1

Title **Maple Hill Trunk – Profile 1**

Client/Project City of Waterloo

Waterloo Sanitary Servicing Master Plan

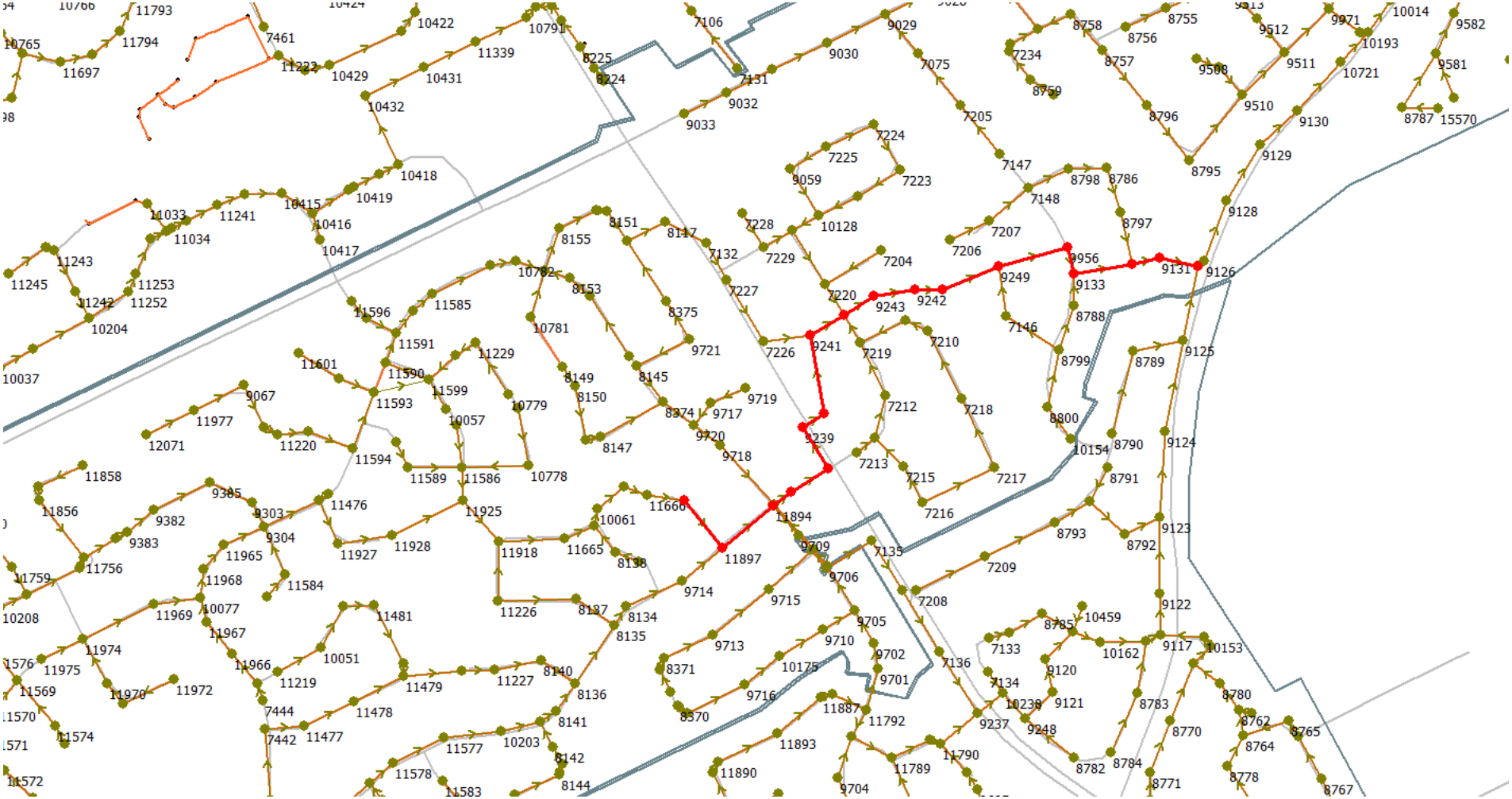

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Figure No. 1

Title **Maple Hill Trunk Profile 2 Overview**

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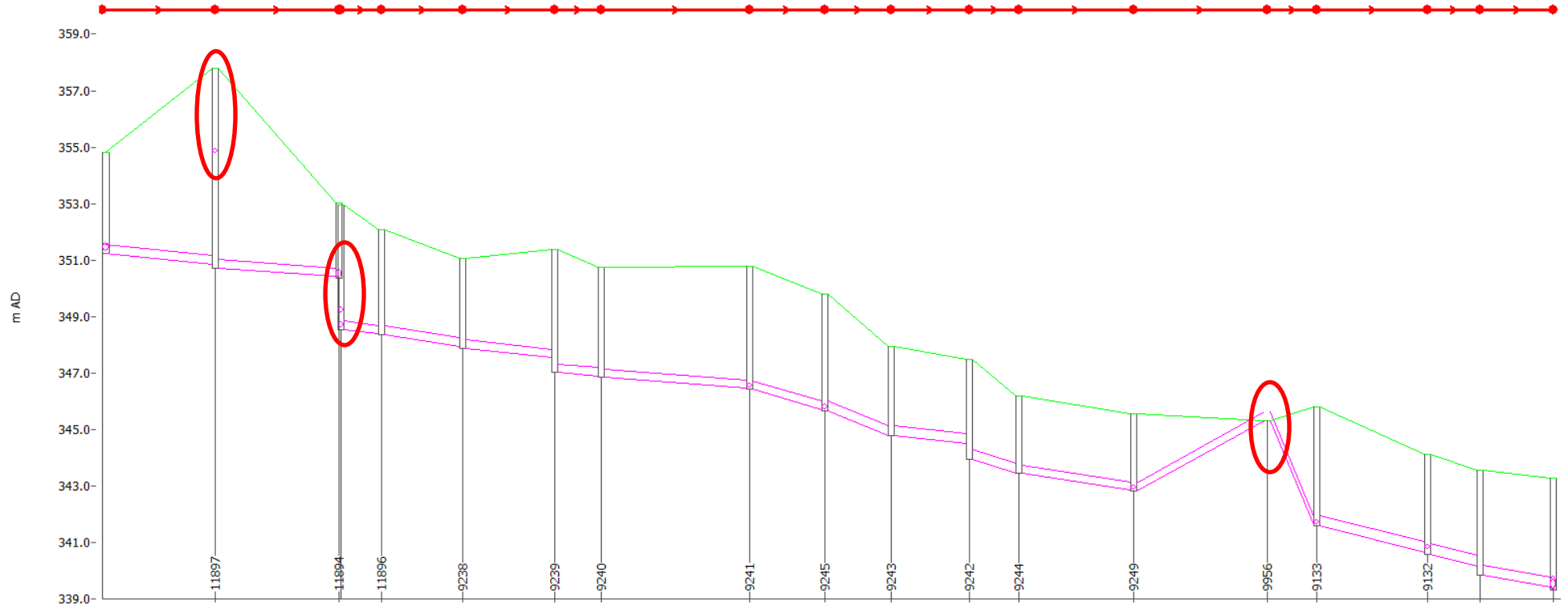

m		84		175	207	267	335	370	480	535	584	642	679	764	863	899	982	1020	107
Link	11892.1	11897.1	-	11896.1	9238.1	9239.1	9240.1	9241.1	9245.1	9243.1	9242.1	9244.1	9249.1	9956.1	9133.1	9132.1	9131.1		
length (m)	83.8	91.5	29.6	60.5	67.5	35.0	110.0	55.1	49.3	58.0	36.9	84.7	98.8	36.7	82.3	38.3	54.4		
width (mm)	300	300	300	300	300	300	300	300	350	350	350	300	300	300	375	375	375		
us inv (m AD)	351.255	350.728	-	348.372	347.896	347.032	346.848	346.440	345.690	344.810	343.970	343.450	342.830	345.330	341.600	340.610	339.850		
ds inv (m AD)	350.855	350.431	-	347.956	347.561	346.908	346.463	345.720	344.810	344.510	343.480	342.860	345.330	341.630	340.670	340.170	339.430		
grad (m/m)	0.00477	0.00325	-	0.00688	0.00496	0.00354	0.00350	0.01308	0.01784	0.00517	0.01328	0.00696	-0.02530	0.10093	0.01129	0.01147	0.00772		
pfc (m3/s)	0.067	0.055	0.069	0.080	0.068	0.058	0.057	0.111	0.195	0.105	0.168	0.081	-0.154	0.307	0.186	0.188	0.154		
User Text 3	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active		
Node	11892	11897	11894	-	11896	9238	9239	9240	9241	9245	9243	9242	9244	9249	9956	9133	9132	9131	9127
ground (m AD)	354.803	357.793	353.023	-	352.082	351.080	351.370	350.760	350.770	349.810	347.960	347.510	346.210	345.550	345.335	345.808	344.115	343.568	-
User Text 2	Active	Active	Active	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	-

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Figure No. 1

Title **Maple Hill Trunk – Profile 2**

Client/Project City of Waterloo

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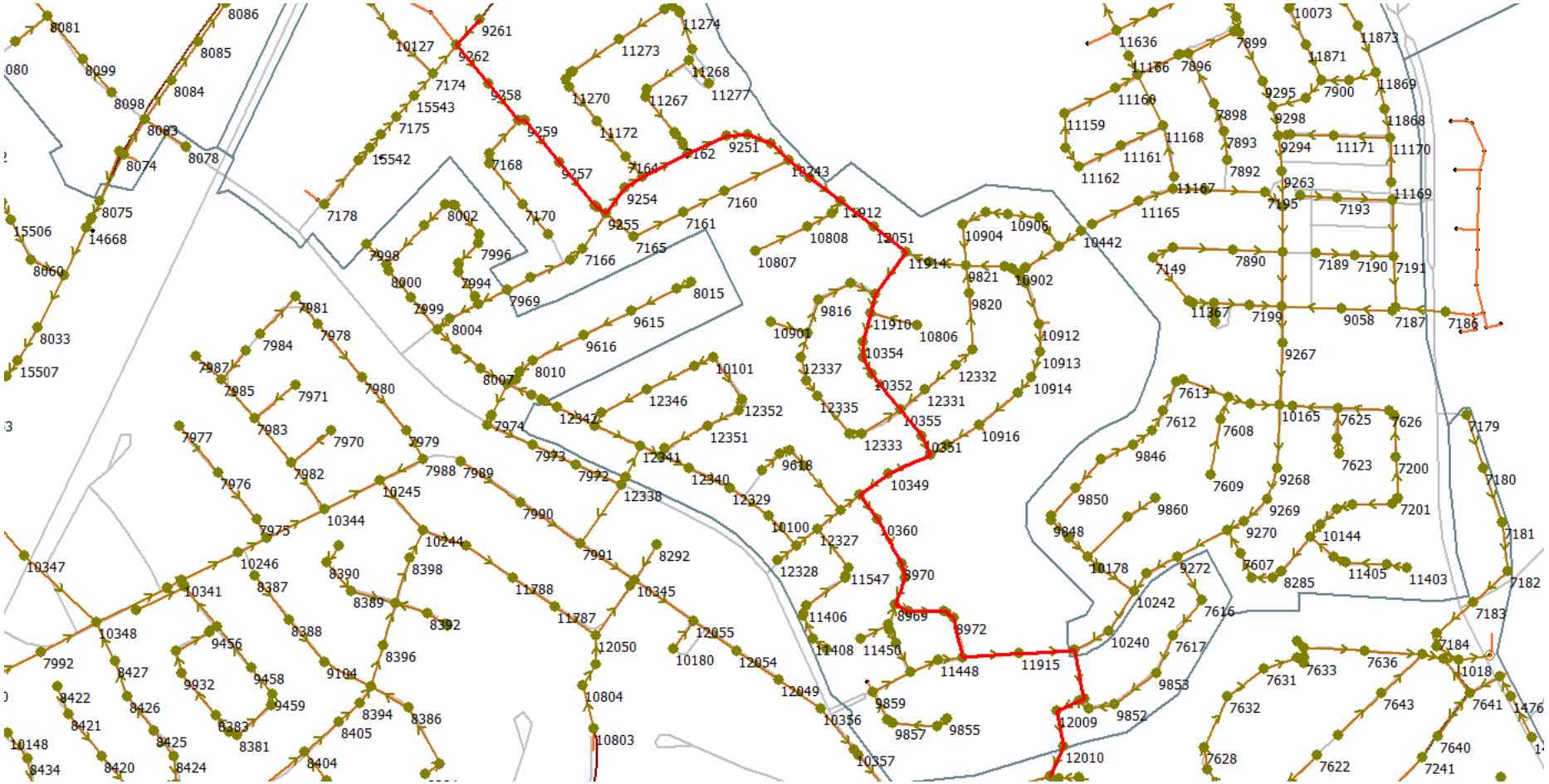

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Figure No. 1

Title **Northland Trunk Geoplan Overview**

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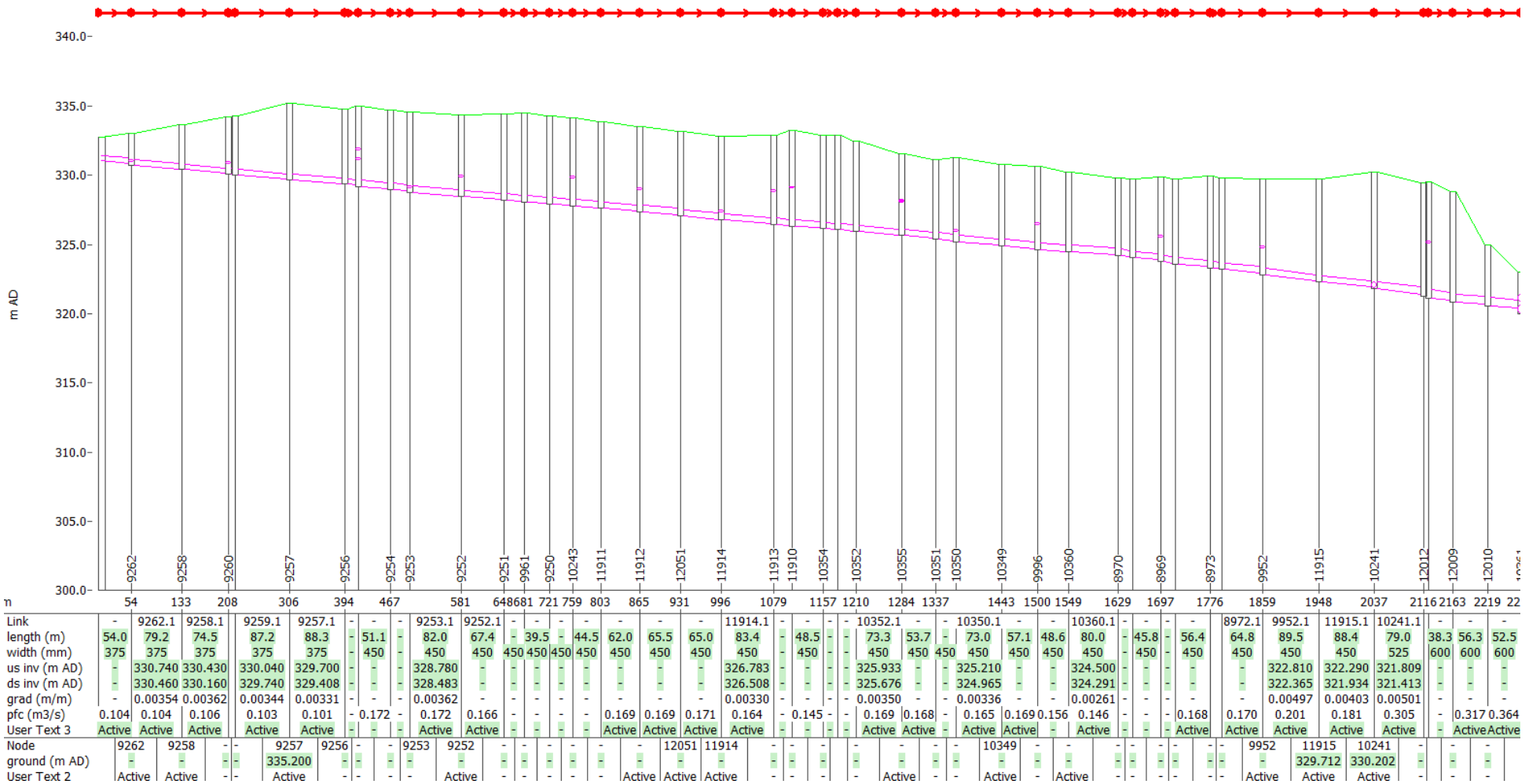

n	54	133	208	306	394	467	581	648	681	721	759	803	865	931	996	1079	1157	1210	1284	1337	1443	1500	1549	1629	1697	1776	1859	1948	2037	2116	2163	2219	22
Link	-	9262.1	9258.1	9259.1	9257.1	-	-	-	9253.1	9252.1	-	-	-	-	-	-	-	11914.1	-	-	-	10352.1	-	-	10350.1	-	-	10360.1	-	-	-	8972.1	9952.1	11915.1	10241.1	-	-	-
length (m)	54.0	79.2	74.5	87.2	88.3	-	51.1	-	82.0	67.4	-	39.5	-	44.5	62.0	65.5	65.0	83.4	-	48.5	-	73.3	53.7	-	73.0	57.1	48.6	80.0	-	45.8	-	56.4	64.8	89.5	88.4	79.0	38.3	56.3	52.5
width (mm)	375	375	375	375	375	-	450	-	450	450	450	450	450	450	450	450	450	450	-	450	-	450	450	450	450	450	450	450	-	450	-	450	450	450	450	525	600	600	600
us inv (m AD)	-	330.740	330.430	330.040	329.700	-	-	-	328.780	-	-	-	-	-	-	-	-	326.783	-	-	-	325.933	-	-	325.210	-	-	324.500	-	-	-	-	322.810	322.290	321.809	-	-	-
ds inv (m AD)	-	330.460	330.160	329.740	329.408	-	-	-	328.483	-	-	-	-	-	-	-	-	326.508	-	-	-	325.676	-	-	324.965	-	-	324.291	-	-	-	-	322.365	321.934	321.413	-	-	-
grad (m/m)	-	0.00354	0.00362	0.00344	0.00331	-	-	-	0.00362	-	-	-	-	-	-	-	-	0.00330	-	-	-	0.00350	-	-	0.00336	-	-	0.00261	-	-	-	-	0.00497	0.00403	0.00501	-	-	-
pfc (m3/s)	0.104	0.104	0.106	0.103	0.101	-	0.172	-	0.172	0.166	-	-	-	-	0.169	0.169	0.171	0.164	-	0.145	-	0.169	0.168	-	0.165	0.169	0.156	0.146	-	-	-	0.168	0.170	0.201	0.181	0.305	-	0.317	0.364
User Text 3	Active	Active	Active	Active	Active	-	-	-	Active	Active	-	-	-	-	Active	Active	Active	Active	-	-	-	Active	Active	-	Active	Active	-	Active	-	-	-	Active	Active	Active	Active	Active	-	Active	Active
Node		9262	9258	-	-	9257	9256	-	-	9253	9252	-	-	-	-	-	-	12051	11914	-	-	-	-	-	-	10349	-	-	-	-	-	-	-	9952	11915	10241	-	-	-
ground (m AD)		-	-	-	-	335.200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	329.712	330.202	-	-	-
User Text 2		Active	Active	-	-	Active	-	-	-	-	Active	-	-	-	-	Active	Active	Active	-	-	-	-	Active	-	-	Active	-	Active	-	-	-	-	-	Active	Active	Active	-	-	-

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Figure No. 1

Title **Northland Trunk Profile**

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Waterloo Sanitary Servicing Master Plan

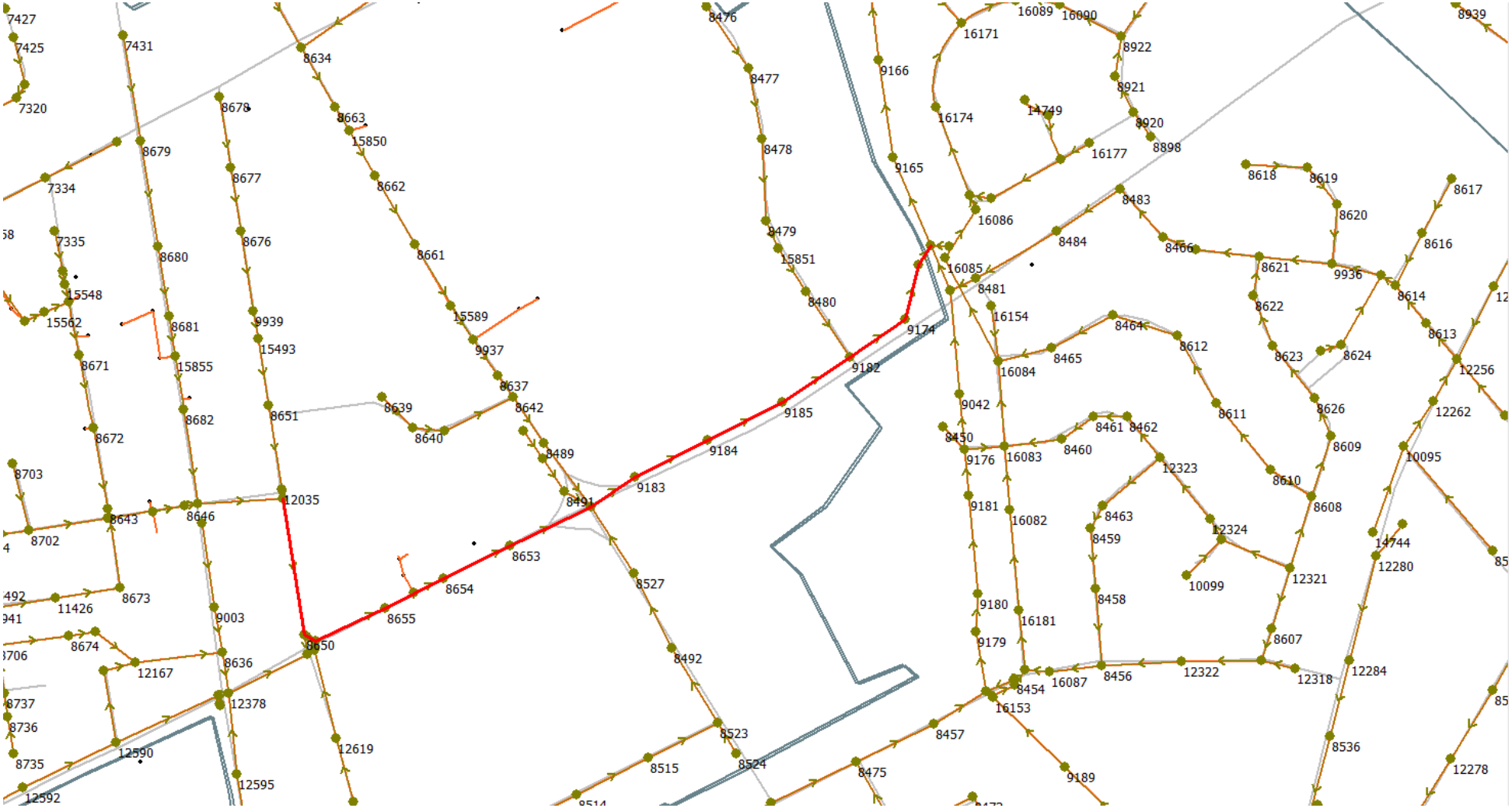

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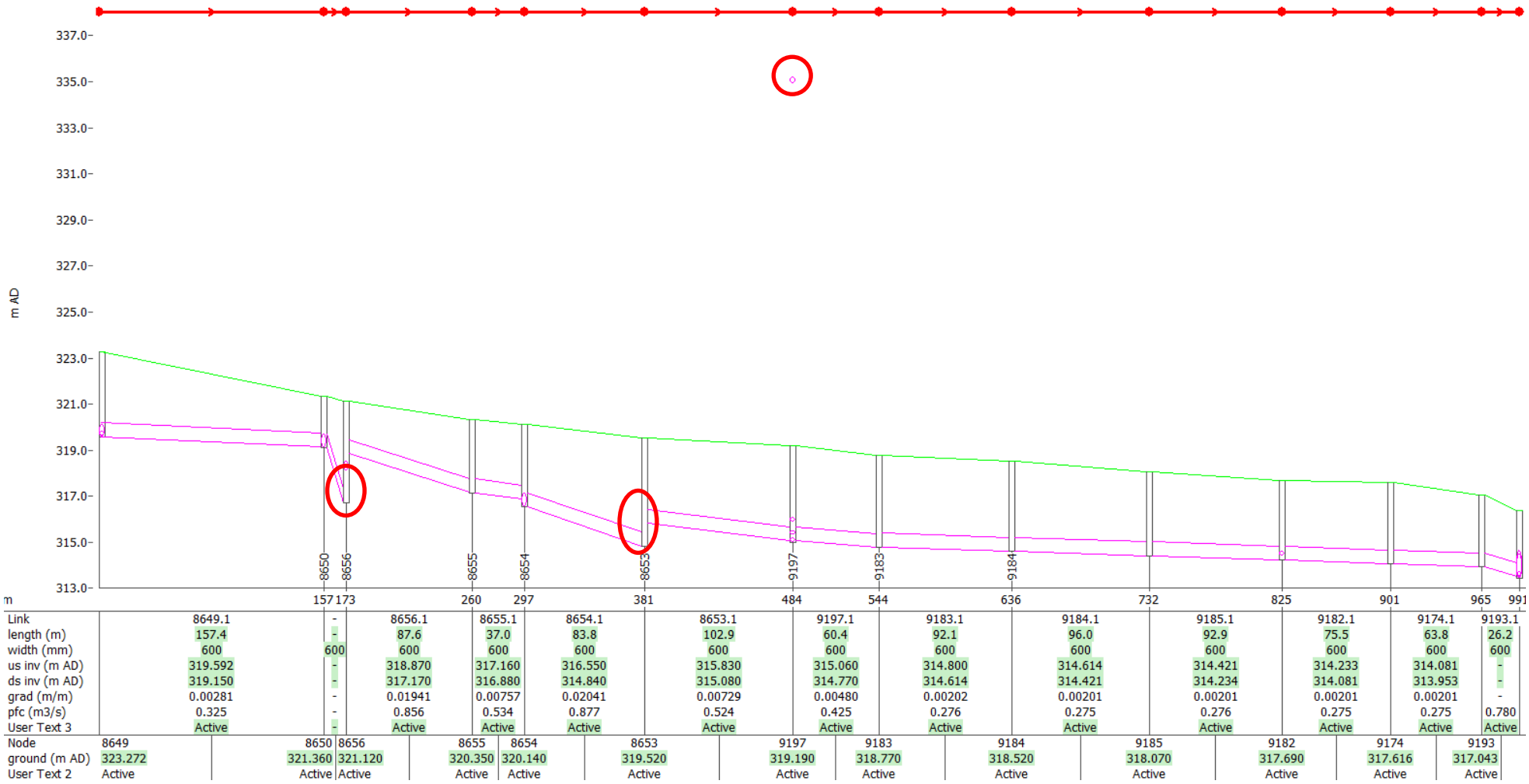
Figure No. 1

Title **University Trunk Geoplan Overview**

Client/Project City of Waterloo

Waterloo Sanitary Servicing Master Plan



Link		8649.1	-	8656.1	8655.1	8654.1	8653.1	9197.1	9183.1	9184.1	9185.1	9182.1	9174.1	9193.1
length (m)		157.4	-	87.6	37.0	83.8	102.9	60.4	92.1	96.0	92.9	75.5	63.8	26.2
width (mm)		600	600	600	600	600	600	600	600	600	600	600	600	600
us inv (m AD)		319.592	-	318.870	317.160	316.550	315.830	315.060	314.800	314.614	314.421	314.233	314.081	-
ds inv (m AD)		319.150	-	317.170	316.880	314.840	315.080	314.770	314.614	314.421	314.234	314.081	313.953	-
grad (m/m)		0.00281	-	0.01941	0.00757	0.02041	0.00729	0.00480	0.00202	0.00201	0.00201	0.00201	0.00201	-
pfc (m3/s)		0.325	-	0.856	0.534	0.877	0.524	0.425	0.276	0.275	0.276	0.275	0.275	0.780
User Text 3		Active	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active
Node	8649		8650	8656	8655	8654	8653	9197	9183	9184	9185	9182	9174	9193
ground (m AD)	323.272		321.360	321.120	320.350	320.140	319.520	319.190	318.770	318.520	318.070	317.690	317.616	317.043
User Text 2	Active		Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active

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Figure No. 1

Title **University Trunk – Profile**

Client/Project City of Waterloo

Waterloo Sanitary Servicing Master Plan

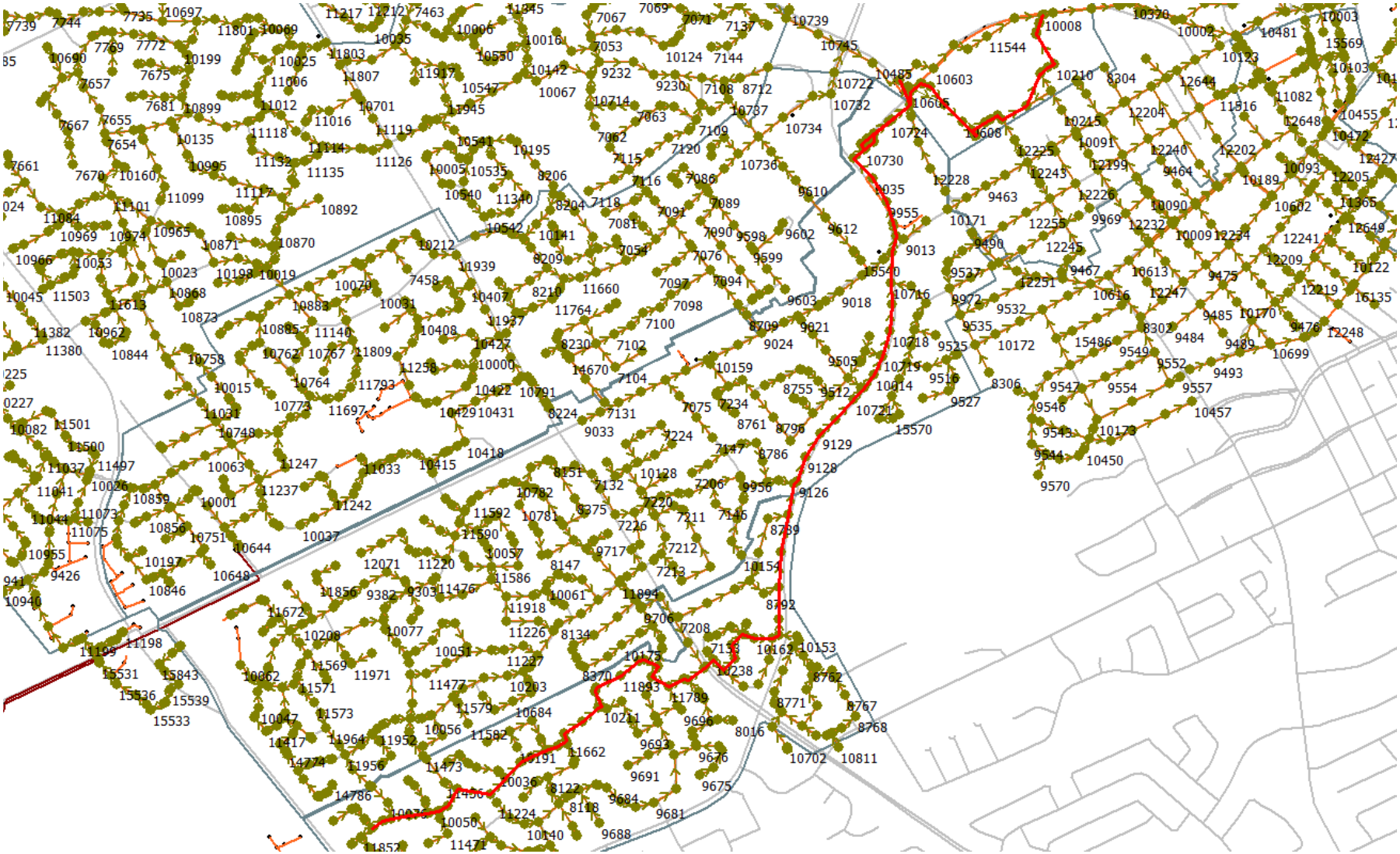

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Figure No. 1

Title **Westvale Trunk Geoplan Overview**

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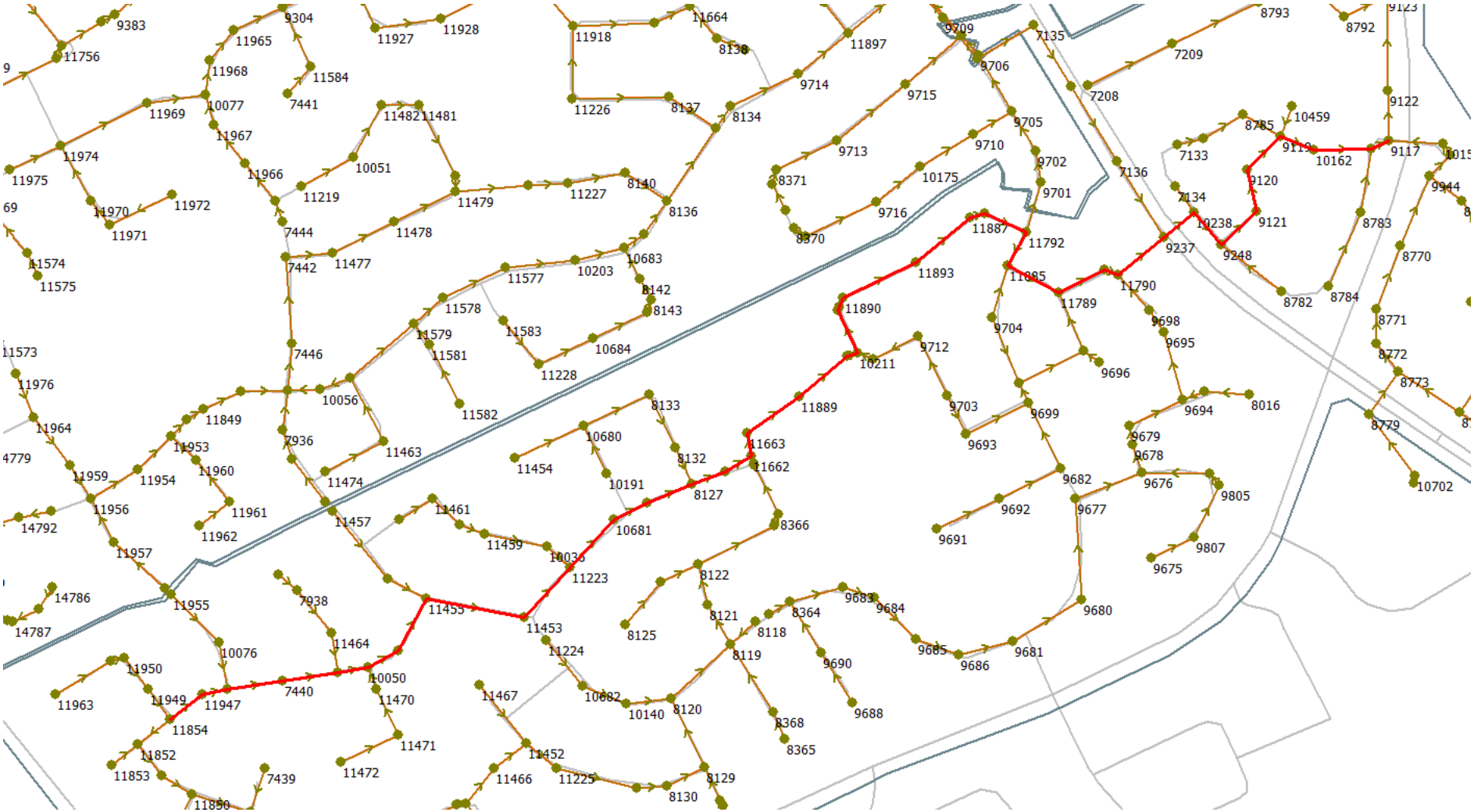

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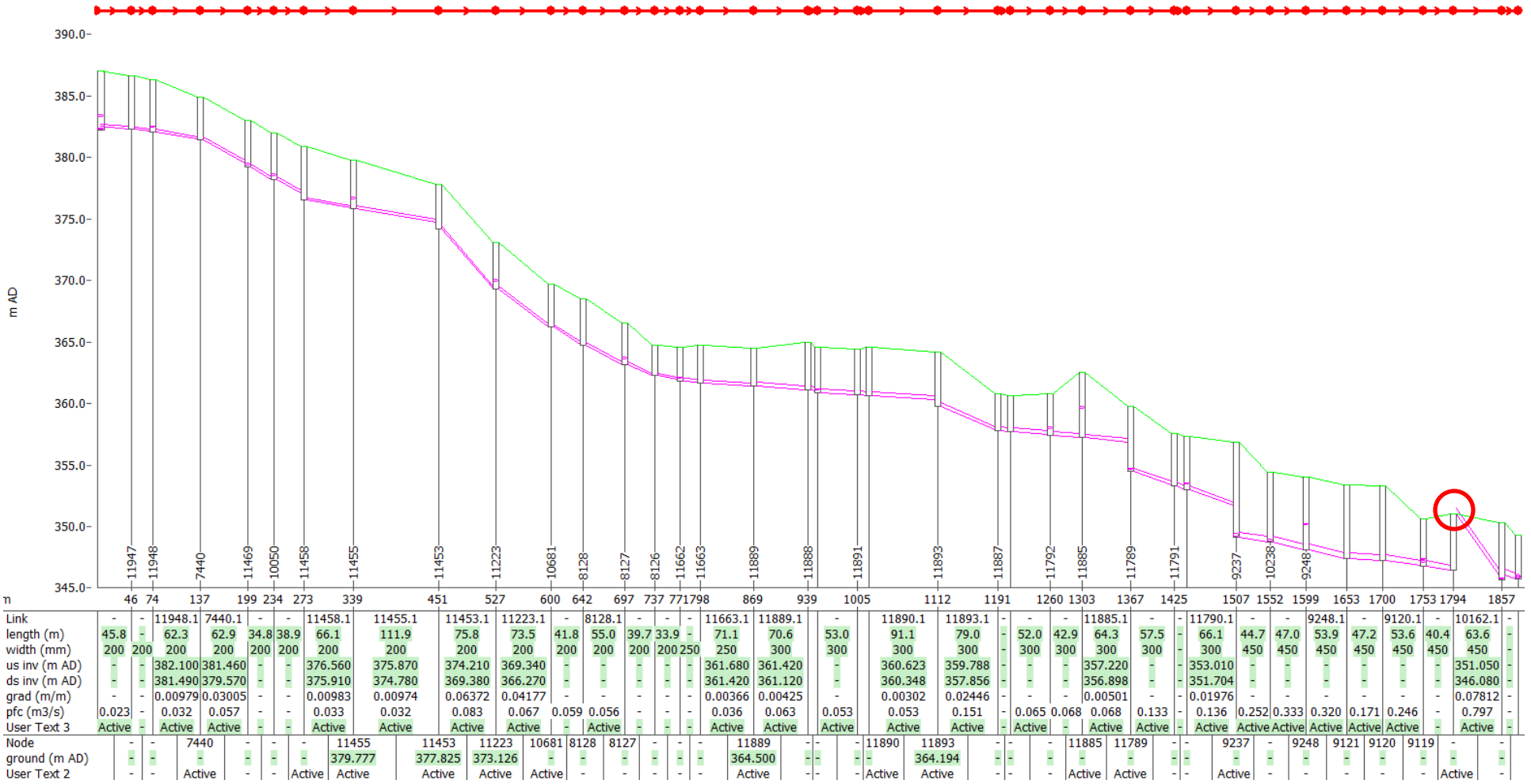
Figure No. 1

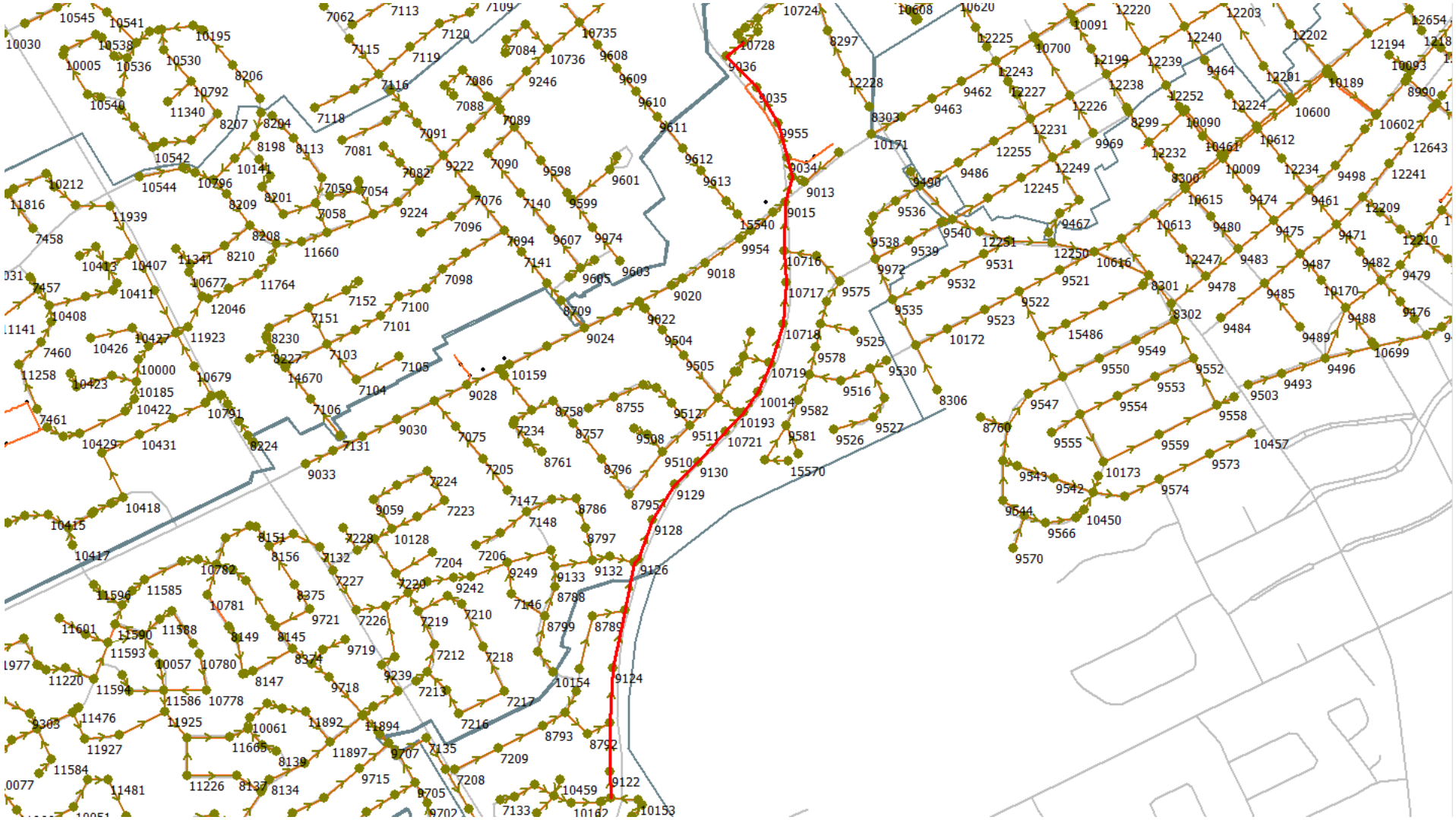
Title **Westvale Trunk Profile 1 Overview**

Client/Project City of Waterloo

Waterloo Sanitary Servicing Master Plan


390.0
385.0
380.0
375.0
370.0
365.0
360.0
355.0
350.0
m AD
11947 11948 7440 11469 10050 11458 11455 11453 11223 10681 8128 8127 8126 11662 11663 11889 11888 11891 11893 11887 11792 11885 11789 11791 9237 10238 9248
n 46 74 137 199 234 273 339 451 527 600 642 697 737 771798 869 939 1005 1112 1191 1260 1303 1367 1425 1507 1552 1599 1653 1700 1753 1794 1857

| | | |



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Legend

Figure No. 1

Title **Westvale Trunk Profile 2 Overview**

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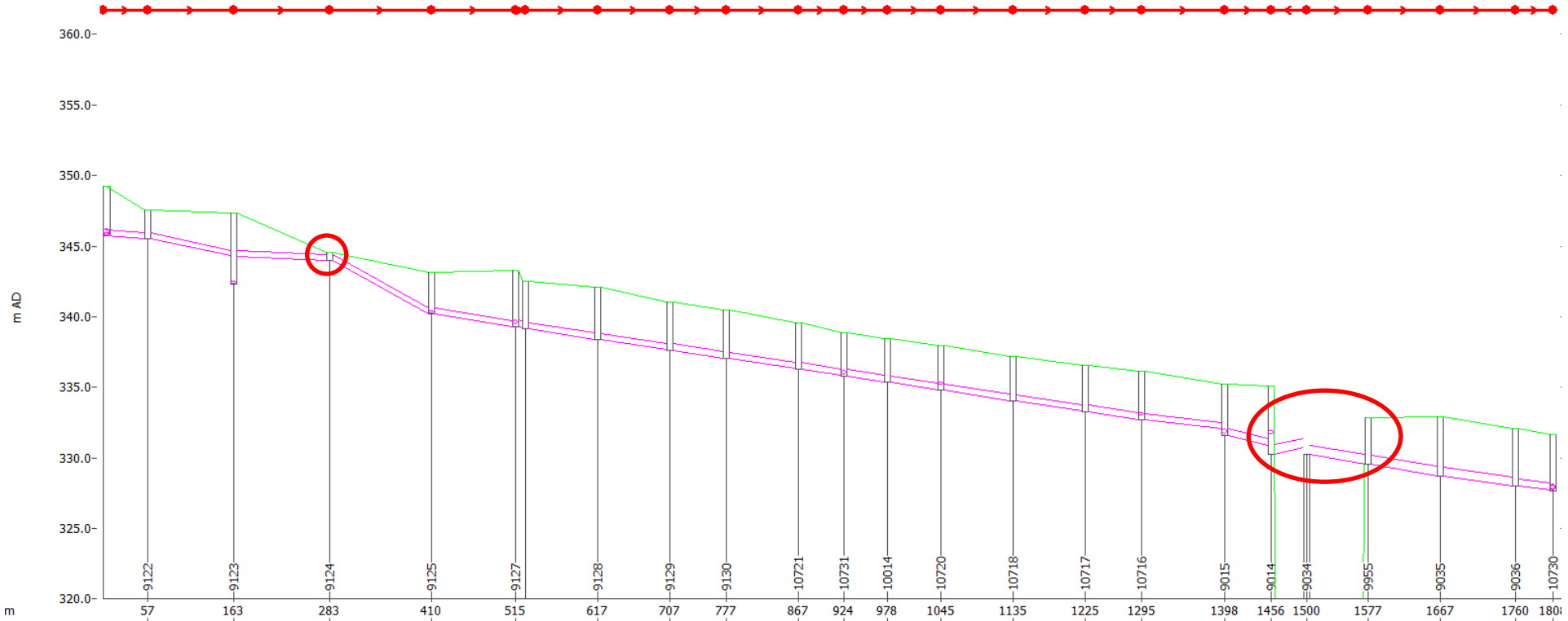

Link	9117.1	9122.1	9123.1	9124.1	9125.1	9126.1	9128.1	9129.1	9130.1	10721.1	-	10014.1	10720.1	10718.1	10717.1	10716.1	9015.1	-	9034.1	9955.1	9035.1	-	
length (m)	56.6	106.3	119.8	127.5	104.8	90.3	90.5	69.9	90.1	56.3	54.0	67.5	89.6	90.1	70.0	103.7	57.6	44.2	76.7	90.0	93.3	47.3	
width (mm)	400	400	400	400	400	450	450	450	450	450	450	450	450	450	450	450	525	675	675	675	675	500	
us inv (m AD)	-	345.540	344.290	344.000	340.210	339.142	338.392	337.642	337.052	336.302	-	335.366	334.792	334.042	333.292	332.704	331.562	-	330.237	329.538	328.699	-	
ds inv (m AD)	-	344.320	344.000	340.230	339.320	338.422	337.672	337.082	336.332	335.850	-	334.822	334.072	333.322	332.734	332.065	330.891	-	329.568	328.728	328.010	-	
grad (m/m)	-	0.01148	0.00242	0.02957	0.00849	0.00798	0.00795	0.00802	0.00799	0.00803	-	0.00806	0.00804	0.00799	0.00797	0.00616	0.01165	-	0.00872	0.00900	0.00738	-	
pfc (m3/s)	0.127	0.223	0.103	0.358	0.192	0.255	0.254	0.255	0.255	0.256	0.253	0.256	0.256	0.255	0.255	0.224	0.464	0.854	0.785	0.798	0.722	0.274	
User Text 3	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	

Node	-	9122	9123	9124	9125	9127	9126	9128	9129	9130	10721	10731	10014	10720	10718	10717	10716	9015	9014	9034	9955	9035	9036
ground (m AD)	-	347.540	347.356	344.585	343.162	-	-	342.090	341.080	340.470	339.580	-	-	337.940	337.230	336.570	336.140	335.235	-	0.000	332.846	332.913	332.090
User Text 2	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active

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Figure No. 1

Title **Westvale Trunk – Profile 2**

Stantec Consulting Ltd.
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Tel: (519) 579-4410
Fax: (519) 579-6733
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Client/Project City of Waterloo

Waterloo Sanitary Servicing Master Plan

Drawing is not to be used for construction

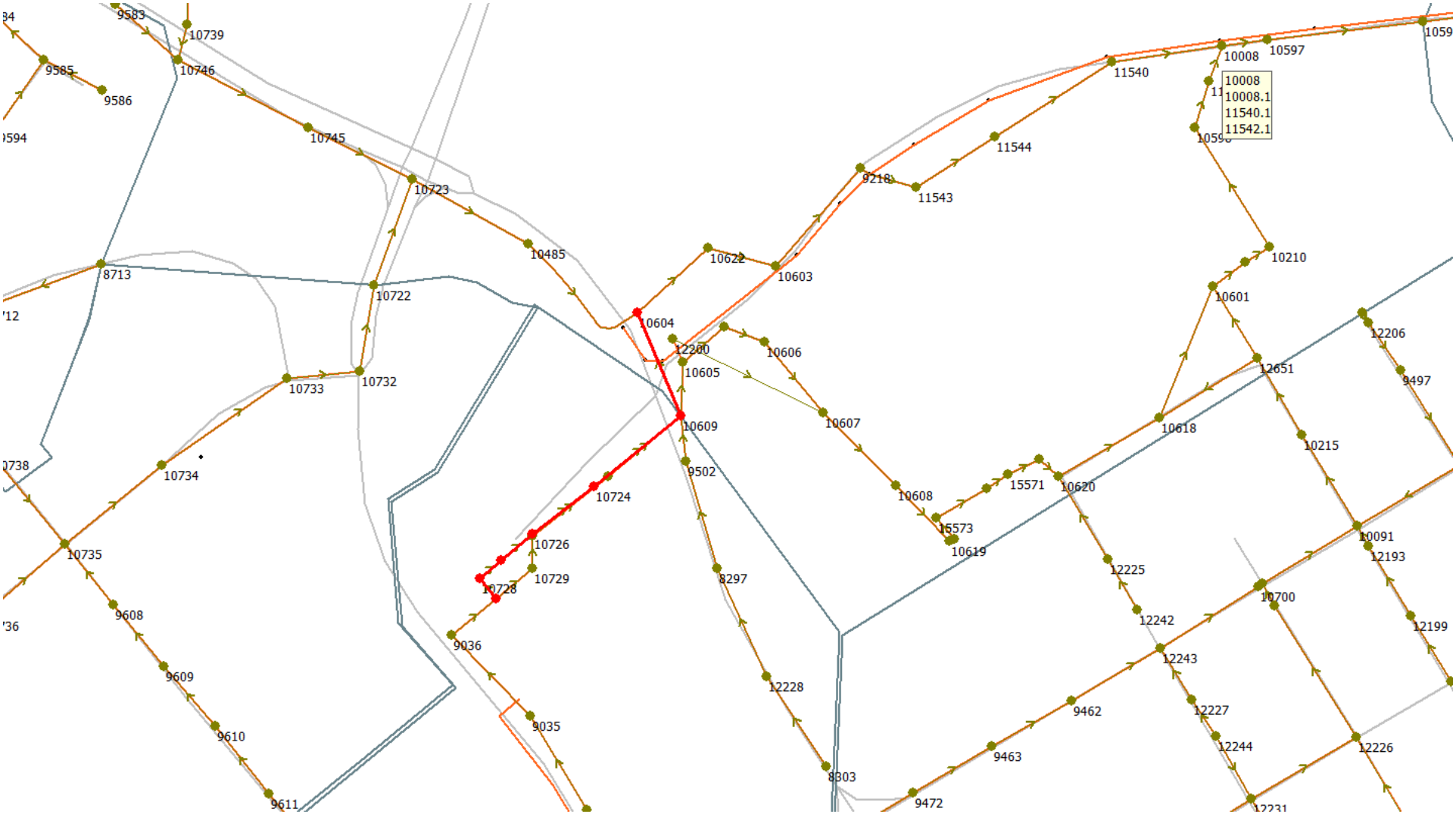

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Figure No. 1

Title **Westvale Trunk Profile 3 Overview**

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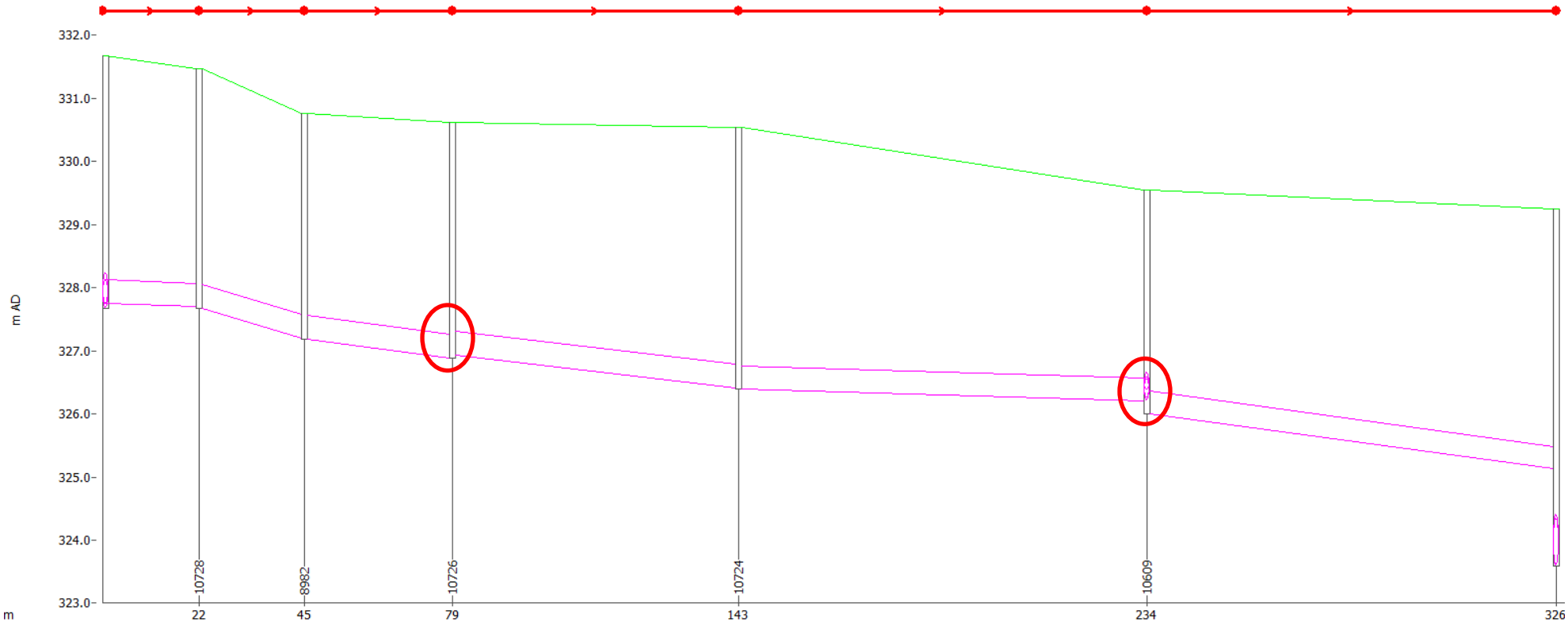

Link	10730.1	10728.1	8982.1	10726.1	10724.1	10609.2
length (m)	21.7	23.6	33.4	64.2	91.6	91.8
width (mm)	375	375	375	375	375	350
us inv (m AD)	327.750	327.670	327.190	326.930	326.390	326.010
ds inv (m AD)	327.700	327.200	326.890	326.420	326.200	325.130
grad (m/m)	0.00231	0.01992	0.00898	0.00795	0.00207	0.00959
pfc (m3/s)	0.084	0.247	0.166	0.156	0.080	0.143
User Text 3	Active	Active	Active	Active	Active	Active

Node	10730	10728	8982	10726	10724	10609	10604
ground (m AD)	-	331.470	330.760	330.620	330.546	329.550	329.245
User Text 2	Active	Active	Active	Active	Active	Active	Active

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Figure No. 1

Title **Westvale Trunk – Profile 3**

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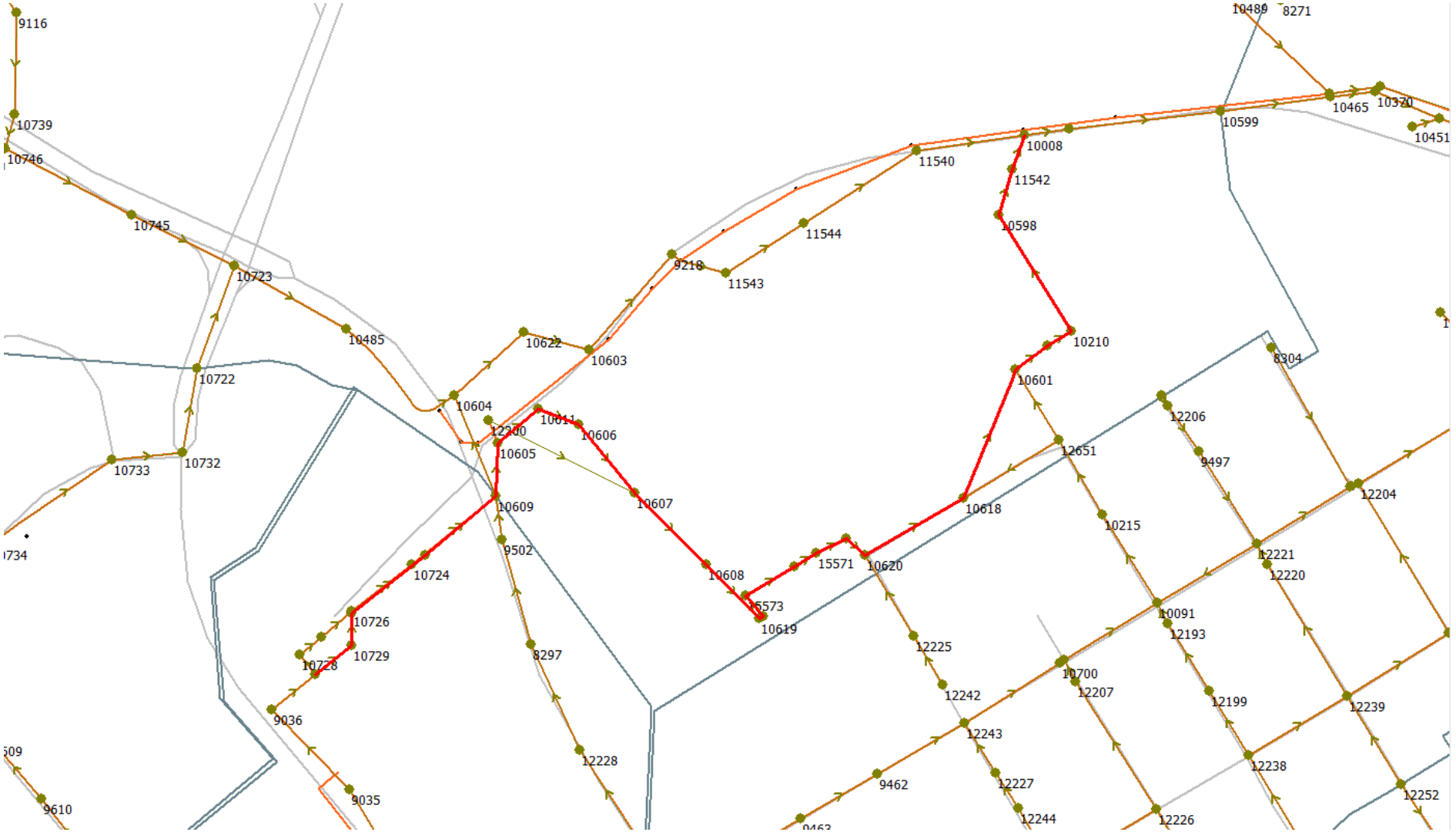

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Figure No. 1

Title **Westvale Trunk Profile 4 Overview**

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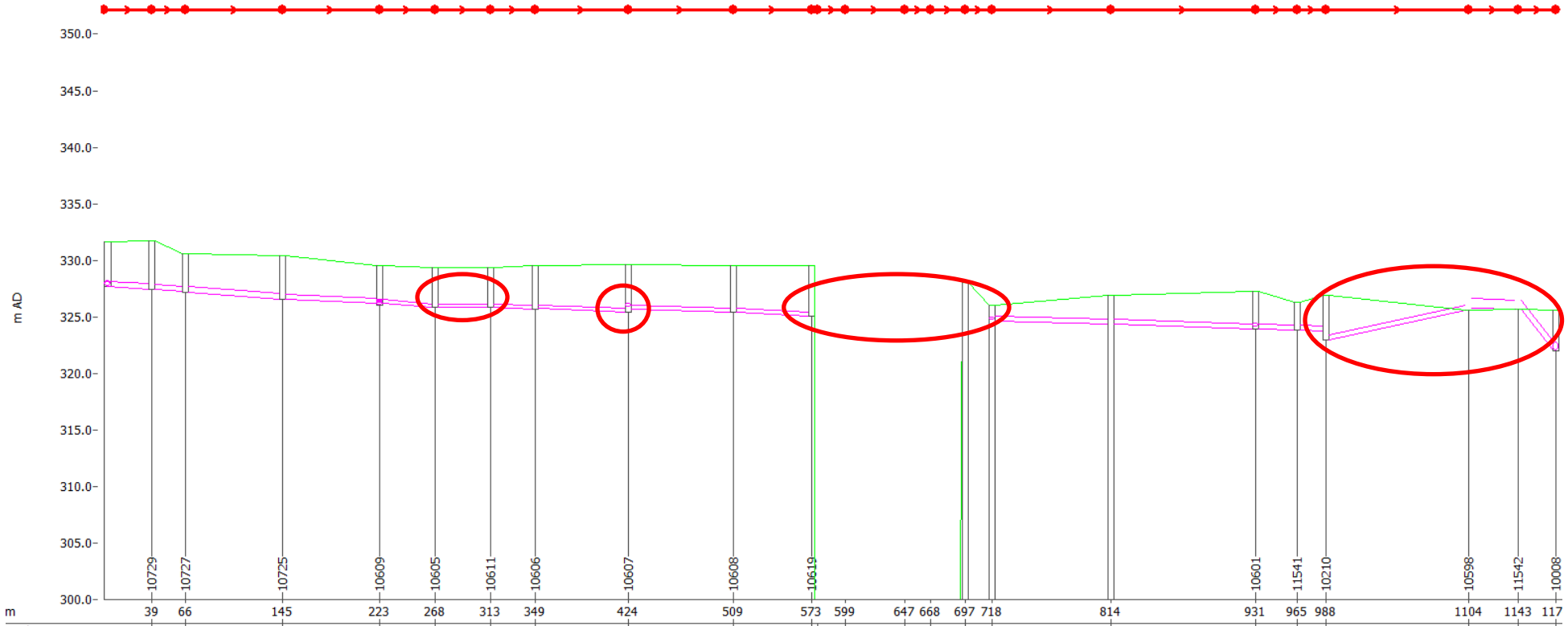

m	39	66	145	223	268	313	349	424	509	573	599	647	668	697	718	814	931	965	988	1104	1143	1170
Link	10730.2	-	10727.1	10725.1	10609.1	10605.1	-	10606.1	10607.1	10608.1	-	15573.1	-	-	-	10620.1	10618.1	-	-	10210.1	10598.1	-
length (m)	39.0	26.9	79.0	77.9	44.8	45.0	36.0	75.2	84.9	63.9	22.7	47.8	21.2	28.1	21.6	96.0	116.7	33.7	23.1	116.0	39.8	30.7
width (mm)	450	450	450	450	300	300	300	300	300	300	0	0	0	0	375	375	450	450	450	450	825	825
us inv (m AD)	327.680	-	327.230	326.560	326.260	325.860	-	325.770	325.720	325.450	-	0.000	-	0.000	-	324.670	324.390	-	-	322.980	325.800	-
ds inv (m AD)	327.490	-	326.610	326.210	325.840	325.860	-	325.460	325.450	325.120	-	0.000	-	0.000	-	324.426	323.930	-	-	325.580	325.690	-
grad (m/m)	0.00487	-	0.00785	0.00449	0.00938	0.00000	-	0.00412	0.00318	0.00517	-	0.00000	-	-	-	0.00254	0.00394	-	-	-0.02241	0.00276	-
pfc (m3/s)	0.199	0.258	0.253	0.191	0.094	0.000	0.064	0.062	0.055	0.070					-	0.088	0.179	0.130	-	-0.427	0.755	4.908
User Text 3	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	-	Active	-	Active	-	Active	Active	Active	-	Active	Active	Active

Node	-	-	10727	10725	10609	10605	10611	10606	10607	10608	10619	15573	15572	-	-	10620	10618	10601	-	10210	10598	11542
ground (m AD)	-	-	330.630	330.463	329.550	329.350	-	329.520	329.620	329.530	-	0.000	0.000	-	-	326.094	326.920	327.310	-	326.950	325.580	-
User Text 2	-	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	-	-	Active	Active	Active	-	Active	Active	Active

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Figure No. 1

Title **Westvale Trunk – Profile 4**

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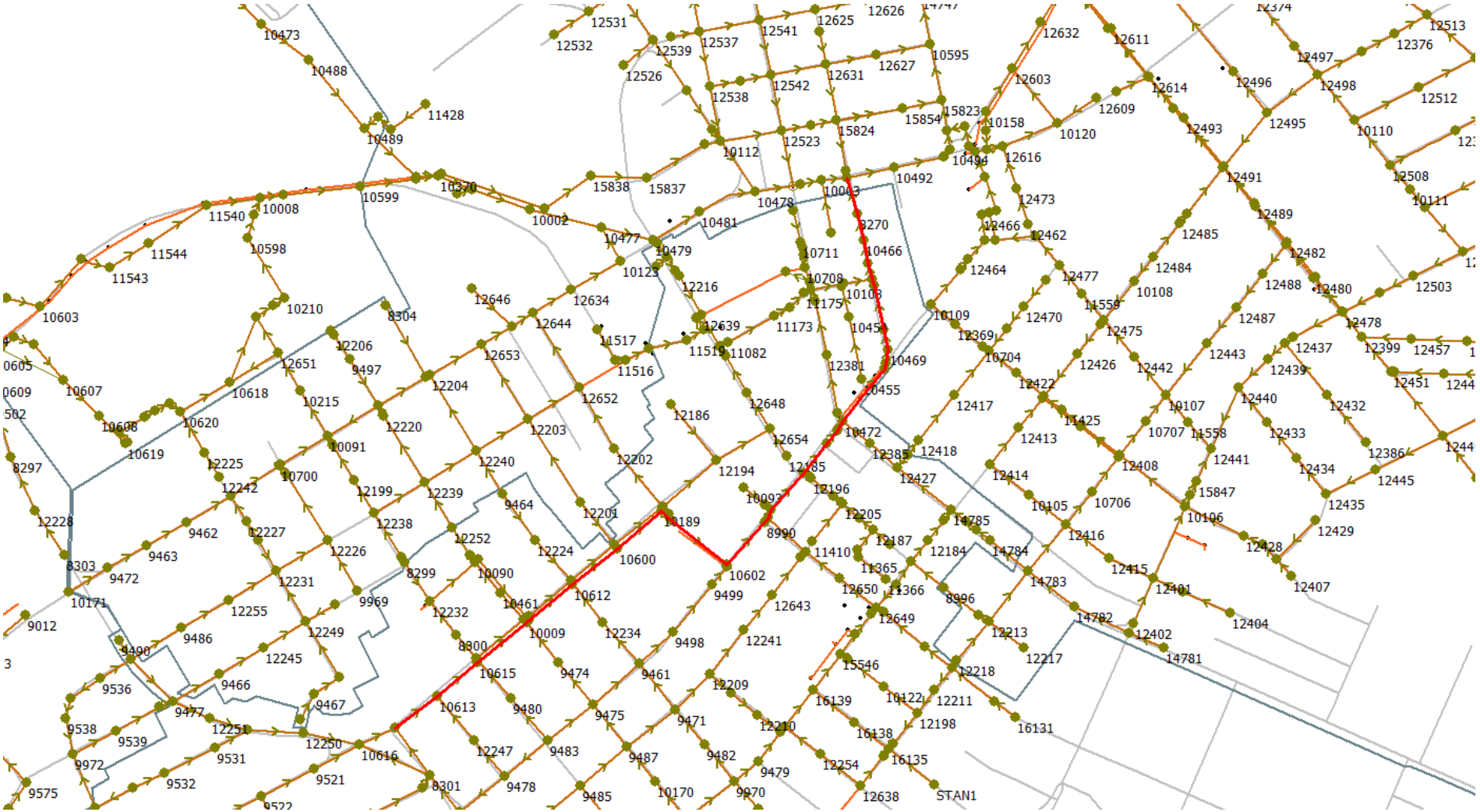

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Figure No. 1

Title **William Trunk Geoplan Overview**

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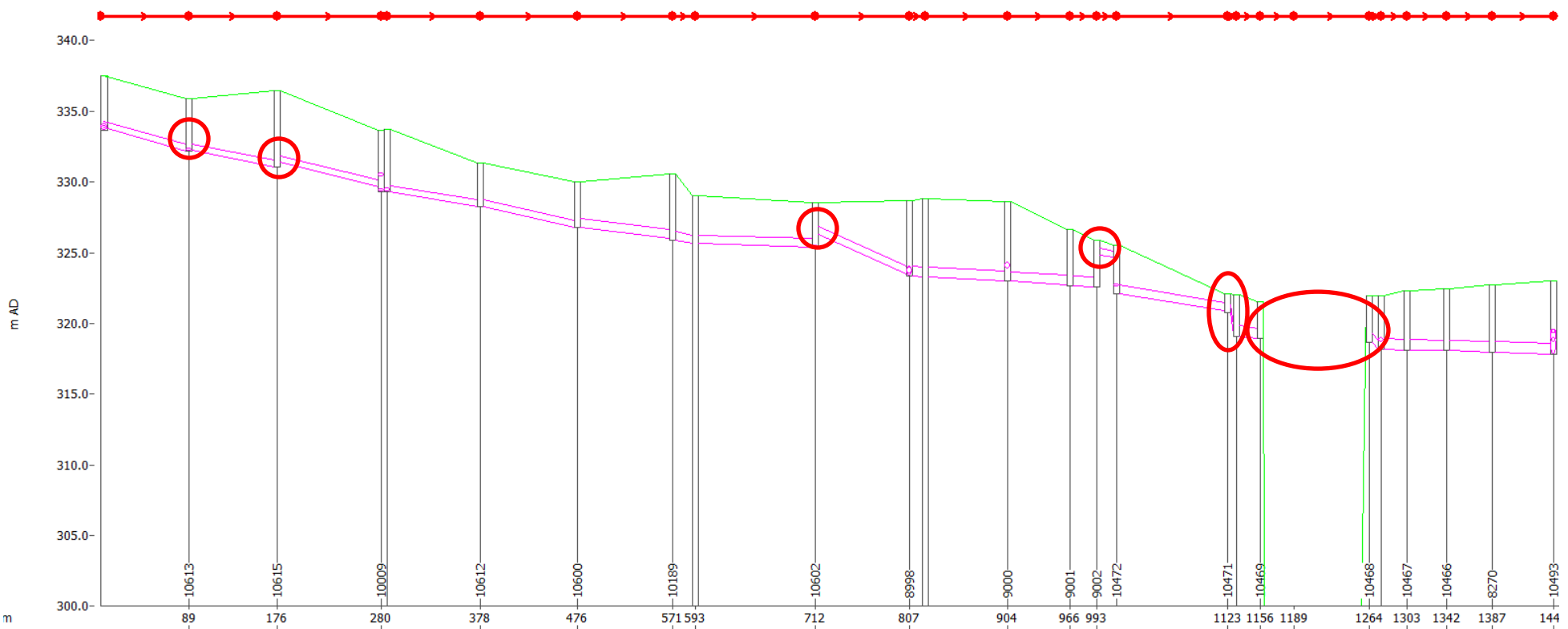

m		89	176	280	378	476	571	593	712	807	904	966	993	1123	1156	1189	1264	1303	1342	1387	144
Link	10617.1	10613.1	10615.1	10614.1	10612.1	10600.1	-	10610.1	10602.1	-	9953.1	9000.1	-	-	10472.1	-	-	15498.1	-	-	10466.1	8270.1
length (m)	88.5	87.4	104.4	92.8	97.6	94.7	-	119.8	94.3	-	81.7	62.4	27.0	-	110.5	-	33.7	75.0	26.0	38.9	45.3	61.9
width (mm)	450	450	450	450	450	600	600	600	600	-	675	675	675	-	600	750	750	750	750	750	750	750
us inv (m AD)	333.850	332.250	331.420	329.290	328.290	326.830	-	325.650	326.270	-	323.310	322.990	-	-	322.130	-			-	-	318.078	317.981
ds inv (m AD)	332.210	331.090	329.680	328.290	326.830	326.040	-	325.410	323.470	-	323.020	322.760	-	-	320.880	-			-	-	317.981	317.840
grad (m/m)	0.01853	0.01327	0.01667	0.01078	0.01496	0.00834	-	0.00200	0.02968	-	0.00355	0.00369	-	-	0.01131	-	-	0.00000	-	-	0.00214	0.00228
pfc (m3/s)	0.388	0.329	0.368	0.296	0.349	0.561	-	0.275	1.058	-	0.501	0.510	-	-	0.653	-	0.000	0.000	-	0.252	0.515	0.531
User Text 3	Active	Active	Active	Active	Active	Active	-	Active	Active	-	Active	Active	-	-	Active	-	Active	Active	-	Active	Active	Active
Node	10617	10613	10615	10009	10614	10612	10600	10189	10610	10602	8998	9953	9000	9001	-	10472	10471	-	15498	10468	-	10466	8270	-
ground (m AD)	-	335.920	336.460	333.680	-	331.340	330.030	330.572	329.061	328.529	328.683	-	328.638	-	-	325.560	322.080	-	0.000	-	-	-	322.710	-
User Text 2	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	-	Active	Active	-	Active	Active	-	Active	Active	-

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Figure No. 1

Title **William Trunk – Profile**

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Waterloo Sanitary Servicing Master Plan

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